SEPTEMBER, 1942

ELECTRICAL SOUTH

52-In Hotel Type

FANS by HUNTER-CENTURY

55th SEASON

24-In "Airspread" Ceiling

HUNTER, who has made fans and ventilators exclusively during 55 years, is now operating under War Production Board restrictions. • No more fans will be made except for the Army, Navy and Maritime Commission. • HUNTER unfilled orders now on hand total 98 percent direct contracts with Government Agencies. • HUNTER can accept orders for certain types to be manufactured for the Army, Navy and Maritime Commission.

HUNTER FAN & VENTILATING COMPANY, INC.

Factory: FULTON, N. Y.

General Sales Offices: Memphis, Sterick Bldg. *Eastern Sales Office:* New York, 92 Warren Street *Western Sales Office:* St. Louis, 1706 Olive Street

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CHICAGO
DALLAS
HOUSTON
LOS ANGELES
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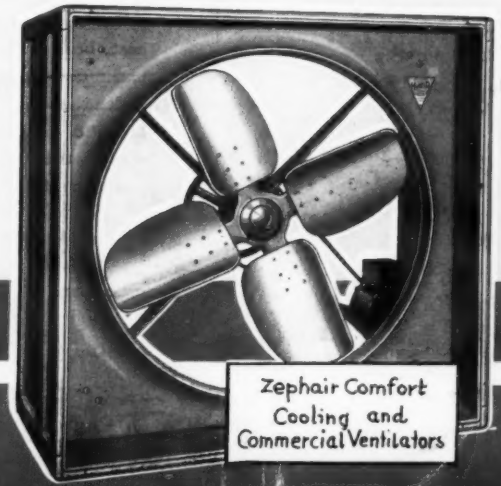

Zephair Comfort Cooling and Commercial Ventilators

Sales Offices:
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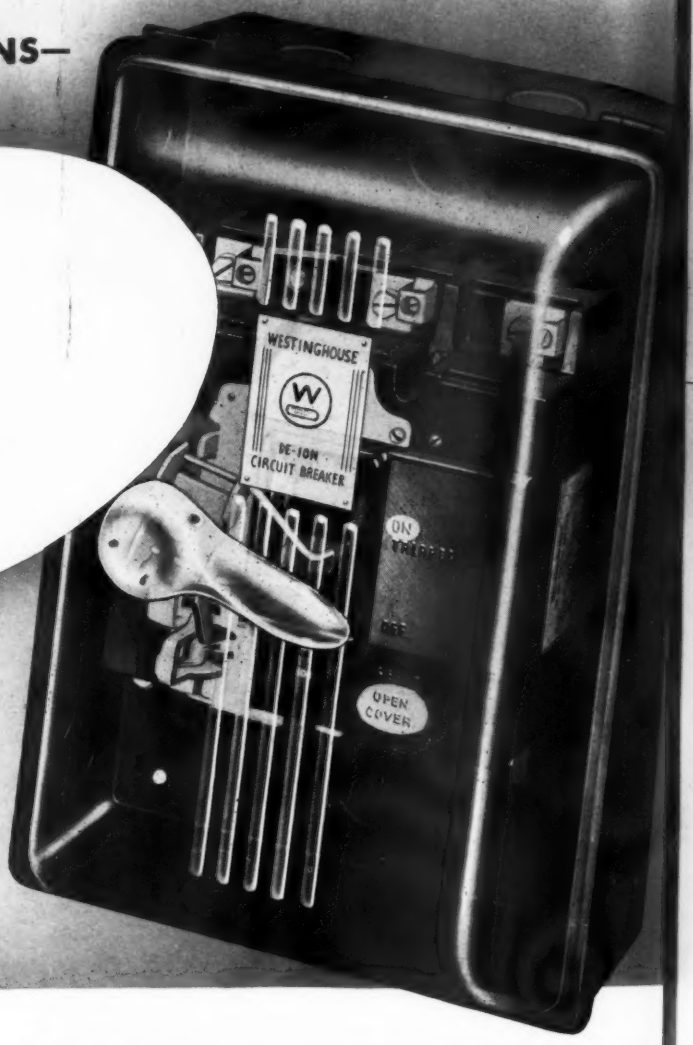
PITTSBURGH

FEWER INTERRUPTIONS—

SHORTER INTERRUPTIONS—

saves time FOR MEN

AND MACHINES!



WESTINGHOUSE "De-ion" TYPE AB-I CIRCUIT BREAKERS

You get **FEWER** service interruptions with the AB-I Circuit Breaker on the job, because its accurate, unvarying Bi-metal protection acts ONLY when the circuit is actually threatened. Momentary or harmless overloads, as when motors are started across-the-line, won't cause unnecessary time outs.

You get **SHORTER** interruptions, too, because there's nothing to renew or replace. Just move the indicating handle which always signals when the circuit has been opened—and service is restored in seconds!

Minutes mean money when machines are out of action. Install these Westinghouse time savers on important circuits and pay for them in lost time saved! Easy to install—ratings from 15 to 600 amperes, according to commercial wire sizes—enclosures for any service. Call your nearest Westinghouse Agent—today! Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. J-21187-A

HERE'S HOW WESTINGHOUSE BI-METAL PROTECTS PRODUCTION CIRCUITS

Two different metals bonded together and affected differently by heat, bend with a curling action under dangerous overloads. This action trips the interrupting mechanism of the "De-ion" breaker, opening the circuit before dangerous current values are reached.

Westinghouse

Save Rubber and Copper... assure lasting trouble-free power distribution with Okonite V. C. Cables

For power wiring, you can't afford to overlook these timely advantages of Okonite V. C. Cable

REQUIRES NO RUBBER – SAVES COPPER
Insulated with varnished cambric instead of rubber, Okonite V. C. cable not only saves this precious material, but copper, too, can be saved as the higher heat resistance of varnished cambric makes it possible to use a smaller conductor to carry the same load.

EASY INSTALLATIONS
Okonite V. C. cable is fast and simple to splice, requires no special tools or methods. It handles easily.

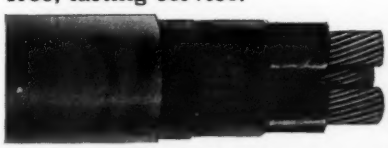
OUTSTANDING SERVICE RECORDS
Under all sorts of operating conditions and over long periods of time, Okonite V. C. cable has set records for trouble-free, lasting service.

FOR JOBS UP TO 28,000 VOLTS
Okonite V. C. cable is made in a complete range of sizes up to and including 28,000 volts. What's more, you can order it with various types of protective coverings to meet particular requirements best.

For complete information on Okonite V. C. cable or for help with any insulated wire or cable problem, call on our experienced engineers. They are ready to assist any time without obligation to submit designs and estimates.

Meets all current IPCEA and Marine Specifications

THE OKONITE COMPANY
Passaic, New Jersey
Offices in Principal Cities



OKONITE
INSULATED WIRES AND CABLES

BUY U.S. WAR BONDS—Every Payday. All Okonite Employees BUY U.S. WAR BONDS.

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Entered as second class matter at the postoffice, Marietta, Ga., under Act of March 3, 1879.

WARTIME LIGHTING COSTS REDUCED!

General Electric announces a 12% to 17% reduction in the price of G-E MAZDA FLUORESCENT LAMPS!

Effective September 1, 1942
NEW LOW PRICES ON G-E MAZDA F LAMPS
14-WATT T-12 . . . was 80c . . . now 70c
15-WATT T-8 . . . was 65c . . . now 57c
15-WATT T-12 . . . was 80c . . . now 70c
20-WATT T-12 . . . was 80c . . . now 70c
30 WATT T-8 . . . was 80c . . . now 70c
40-WATT T-12 . . . was $1.15 . . . now 95c
100-WATT T-17 . . . was $2.60 . . . now $2.15
Above prices refer to daylight and 3500° white. Prices also reduced on soft white and colored G-E MAZDA F lamps.
Also reduced! G-E MAZDA H (Mercury) LAMPS
400-WATT T-16 AH1 . was $11.00 . now $9.50
400-WATT T-16 BH1 . was $11.00 . now $9.50
3000-WATT T-9½ AH9 . was $45.00 . now $40.00

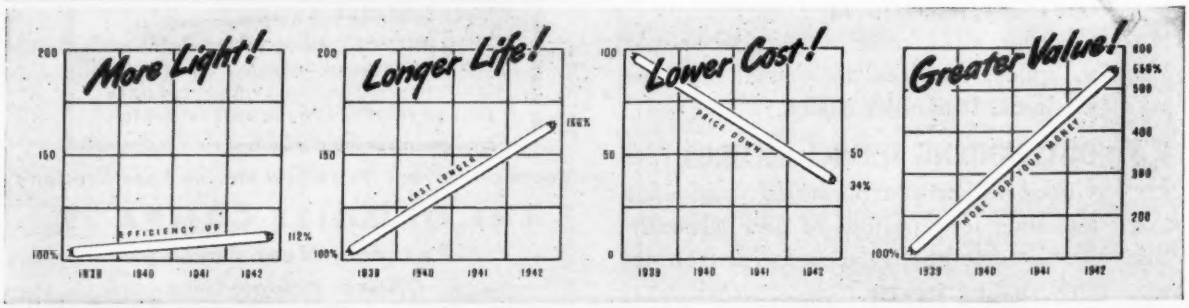
THE SEVENTH REDUCTION IN FOUR YEARS!

NO price reduction, of the many we have been able to make, gave us in General Electric as much genuine satisfaction as this one—made possible at a time when light is being called upon to play a major role in wartime production.

Made in the face of rising cost trends, this reduction is the result of manufacturing economies and technical developments, combined with vastly increased use. It is made in accordance with G-E's policy of passing such savings along to customers.

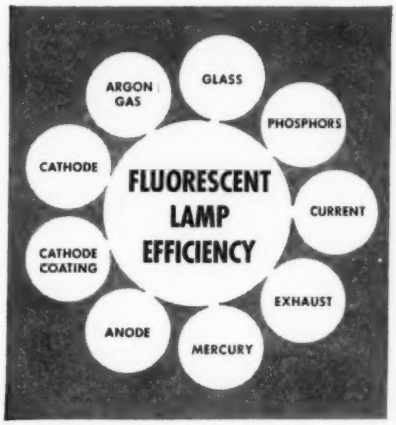
But lower prices are only half the story. Not only have we been able to reduce prices, we have steadily improved these lamps. They give more light! They last longer! They *stay brighter longer!*

For instance, purchasers of the widely used 40-watt white G-E MAZDA F lamp now pay only 95c instead of the $2.80 they paid in 1939. But we are prouder that this lamp lasts 66% longer and is nearly 12% brighter . . . that it gives you 5½ times more value for your lamp dollar than it did in 1939! (See charts below.)

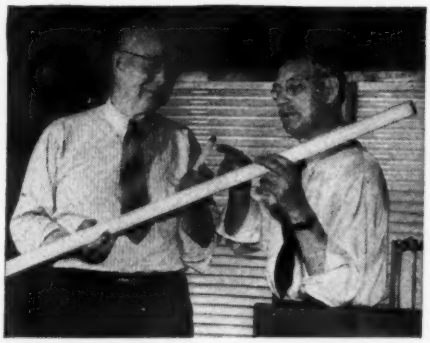


The Story Behind MORE LIGHT for LESS COST

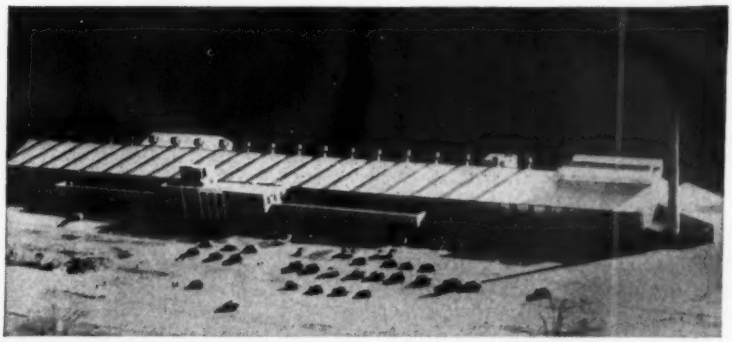
G-E research constantly seeks the best possible combination of all factors affecting lamp efficiency. Here are nine of the most important. There are more than a million possible combinations of these factors. It's the task of G-E research to find the *best* possible combination!



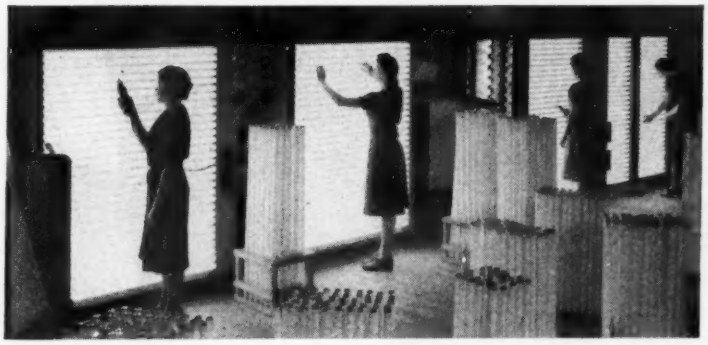
All materials are tested with extreme care. Here, we check the brightness of phosphor powders that coat the inside of fluorescent lamps to make sure that you get maximum performance from your G-E MAZDA F lamps.



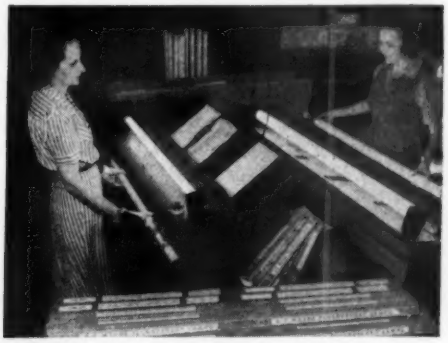
Experience counts. W. L. Enfield (left) and P. J. Pritchard have been active in directing research for better product and lower prices.



Here is one of the new streamlined, specially designed G-E fluorescent lamp factories that have helped materially in reducing costs. Sand for glass tubes comes in at one end. Finished lamps are shipped from the other.



Constant testing guards the quality of G-E MAZDA fluorescent lamps. At every stage in the manufacturing process, General Electric inspections provide safeguards of quality. Above, G-E MAZDA lamps are inspected while undergoing a "seasoning" process on the test racks.



Extra assurance of quality is a series of over 50 tests and checks on completed lamps by MAZDA SERVICE inspectors, who work under the direction of an independent testing laboratory.

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BREMERTON, WASHINGTON
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IN REPLY REFER TO
DIRECT ORDER
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5/8/42
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Seattle, Washington
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JUL 24 1942
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Please deliver the material listed as soon as possible, all transportation charges paid, to
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Dealer to state here (----------DAYS) time required to make delivery.
ITEM No.
ARTICLES AND SERVICES
QUANTITY
Terms ---------- % Discount Cash
201 (17)
200
FLUORESCNET STARTER, for 48" tube.
Starter to be so constructed so that
it will detect a faulty lamp immediately.
If after several attempts, the lamp does not light properly, the
starting switch is cut out of the circuit automatically and remains
out until the faulty lamp is replaced with a good one. Starter to
be similar and equal to Lloyd Products Co., as sold by the Coastal
Sales Co., Seattle, Washington
NO BLINK
STARTER
TO BE
REMOVED
NO BLINK
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Specified
REPEATEDLY
As the Standard of
Quality and
Performance.
The LLOYD NO-BLINK
Starters prevent breakdown of ballasts, condensers and starters themselves.
Prevent "flicker" and "blink".
Start quicker. Work better.
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Listed and Approved by Underwriters' Laboratories Inc., and Canadian Engineering Standards Association.
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Lloyd Policy Insures Quality

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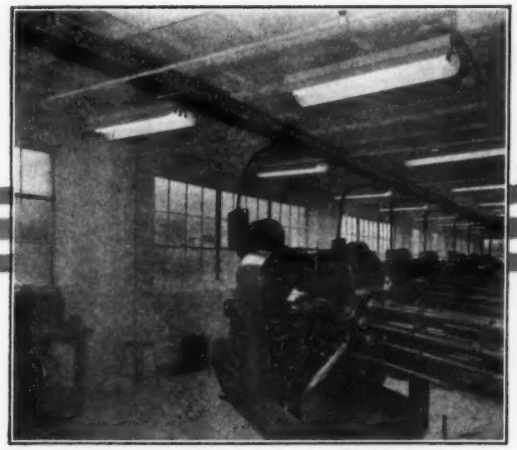
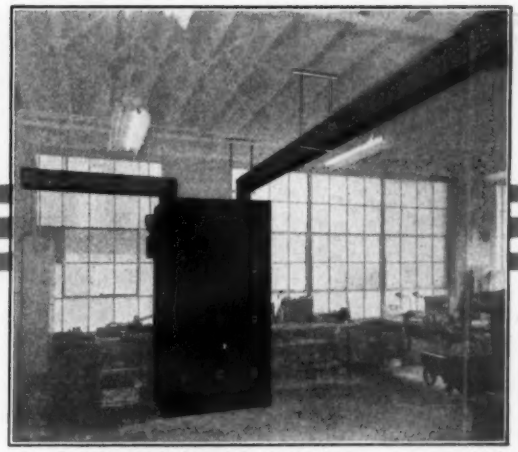


A part of a "loop" system of Plugin (FA) Busduct feeding a battery of automatic screw machines. Low head-room required duct to be mounted against ceiling.



The (FA) KLAMPSWITCHFUZ Switchboard from which Plugin (FA) Busduct in photo at left is fed. Feeder (FA) Busduct at left runs to an existing distribution center.

Plugin (FA) Busduct mounted on edge, with Plugin Outlets in cover and opposite side, simplifies the conduit layout in this installation with its varied types of machines.

Clip Minutes – Save Hours!

Minutes clipped from the time required to make machine connections to the power line mean added hours of production.

(FA) BUSDUCT

helps speed production. This modern, flexible method for the distribution of power and light makes it possible to "move the machine—plug in—go!" at any desired position; for Plugin (FA) Busduct provides plug-in openings at 12-inch intervals.

Both Feeder and Plugin (FA) Busduct may be taken down and moved to new locations without appreciable loss of material. Extensions may be made readily to existing installations.

(FA) Busduct is designed for 2, 3 and 4-wire feeder systems; 250 volt DC, 575 volt AC, maximum. Plugin type capacities, 125 to 1,000 amperes; Feeder type, 250 amperes and up.

Investigate this Modern Method of Electric Distribution
Let the (FA) Sales-Engineer show you how it may be applied to advantage — whether in new construction or plant modernization. His long experience will be helpful — and he will be glad to consult with you — without obligation. Write for his name and address — or see listing in Sweet's Catalog (Architectural Section or Industrial-Engineering Section), in Thomas' Register or in Electrical Buyers' Reference.

Let us send you Bulletin 65
which gives full details of (FA) Busduct installations, with photographs, diagrams and suggested specifications . . . Frank Adam Electric Company, St. Louis, Mo.

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Frank Adam
ELECTRICAL PRODUCTS
for Defense Industry
FRANK ADAM ELECTRIC CO.
ST. LOUIS, MO. U.S.A.

There is no unguarded moment in Anaconda's "control" research; the war program and our industry can thus count on the uniform dependability in every Anaconda wire and cable.

KEEN-MINDED technicians peer intently into metallographic microscopes, day in and day out, watching, watching to see that flawless metals go into every Anaconda wire and cable that is delivered to war-vital work.

Unceasing control like this has earned its "keep". For, throughout industry and now in the army and the navy, users have learned they can lean heavily on the dependability of wires and cables bearing the Anaconda trade-mark. And that isn't all.

They have recognized Anaconda research as a source for many product improvements and for many completely new developments . . . such as Type CB* construction that outlasts ordinary shielded paper-lead cable three to one. This research is a boon to our war effort . . . it will be equally valuable to industry with the return of peace.

*CB—Trade-mark Reg. U. S. Pat. Off. 42242

ANACONDA
from mine to consumer

This familiar trade-mark symbolizes the best efforts of modern research and production.

ELECTRICAL WIRES AND CABLES OF COPPER ARE THE LIFE LINES OF OUR NATION

ANACONDA WIRE & CABLE COMPANY

Subsidiary of Anaconda Copper Mining Company

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SEPTEMBER
1942

Volume 22 No. 9

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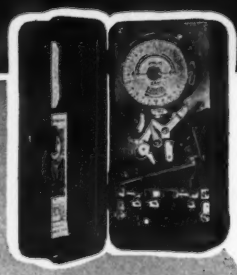
MULTIPLY

THE ADVANTAGES OF PROTECTIVE FLOODLIGHTING WITH . . .

AUTOMATIC CONTROL



DURING BLACK-OUTS

If a master-switch is pulled during temporary black-outs, Form V8WZ will continue to run for 10 hours. During any current interruption, an automatic carry-over feature provides for clock-spring operation of the complete time-switch mechanism. When the current is restored, the clock-spring rewinds automatically and the time-switch resumes its normal operation.

SANGAMO TIME-SWITCHES

THE advantages of protective floodlighting systems for factory yards, building approaches, railroad sidings, storage yards, and other vital property serving in war production, are multiplied when full automatic control is used. A Sangamo Astronomic Dial Time-Switch with synchronous carry-over provides this kind of control. It changes its operating sequence daily, so that the "on" and "off" operations of the lights conform with sunset and sunrise. Its sequence of operations remains undisturbed by power interruptions up to ten hours. It requires no manual operation nor re-setting the year 'round. Select this, or any other form best suited for your specific needs from the complete line of Sangamo Time-Switches.

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS

Lighting for War Production

A graphic survey of the nation-wide progress made in the lighting of our war industries.

By Charles L. Amick*

AMERICA'S battle cry today is "Production." The battle-front is every factory in the land, from large plants down to small garage-sized shops, where planes, ships, tanks, guns, and all the other tools of war and their component parts are being fashioned. Being the Arsenal of Democracy is a stupendous assignment!

But now, the weapons of war pour from our factories in ever-increasing numbers as industry wages her winning battle against *time*. New war plants spring up almost overnight while others swiftly convert their power and machinery to the manufacture of fighting implements.

In this all-out effort for an early victory, light is assuming the same role as in World War I. Industry found then that proper lighting could speed up production by saving precious minutes in setting-up operations and, equally important, that light could help protect the workers against accidents by enabling them to see quickly the things that should be seen.

Today, a quarter of a century later, light assumes an even greater position in meeting the production problems of the present. For not only has more been learned about the relationship of light to vision during the past decade than in the previous century, but today's lighting equipment is far superior to anything available during the last war. In addition, modern lamps are much more efficient than their predecessors and a host of new light sources is available to provide adequate and comfortable illumination for every industrial need.

Evidence of the importance attached to good lighting by those responsible for the success of our

Photograph above shows a corner view of the final assembly department in a new aircraft plant. The two-lamp fluorescent units are located on 11-foot centers and mounted 42 feet above the floor. The illumination level in service is about 30 footcandles.

*Mr. Amick is in General Electric Company's Nela Park Engineering Department, Cleveland, Ohio.

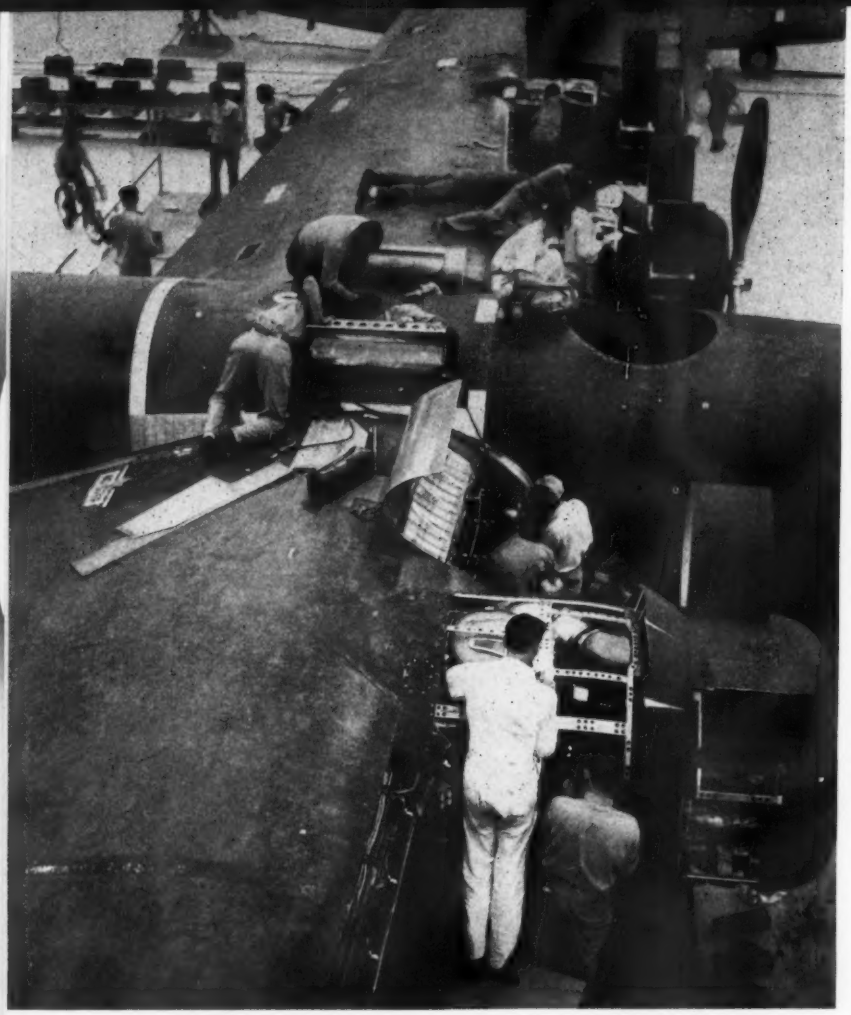


Photo courtesy Austin Company

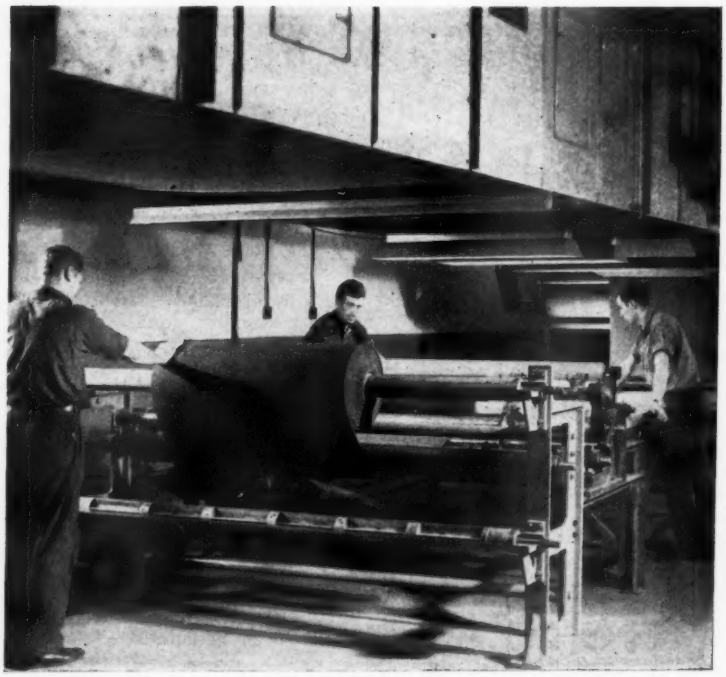
production effort is found in the opening section of the booklet "Plant Efficiency" recently issued by the War Production Board. The publication points out that "good lighting sharpens the worker's most important faculty—sight" and that "it is an effective means of increasing shop efficiency and maintaining production at a high level." The many benefits to the industrial operator of an adequate and well-designed lighting system are also enumerated and explained, as is the importance of lighting quality.

Since a discussion of common lighting faults or "bottlenecks" and their solution is presented elsewhere in the issue, it is the purpose of this article to review various installations in war-production plants and describe the methods employed as an aid to solving similar illumination problems. In addition, the caption material also points out features of certain types of lighting systems which make them particularly appropriate for specific classes of war-production operations.

●

Fluorescent lamps have many applications for supplementary lighting. This illustration shows the arrangement of 40-watt industrial units over the inspection table of an Eastern carpet-mill plant. Over 100 footcandles of comfortable illumination are provided.

This close-up view of a large bomber being produced in one of our large aircraft plants effectively shows how work positions vary in height from the floor level up to 20 feet or more, since planes which have a range of better than 3000 miles and can handle bomb loads in excess of four tons naturally assume large proportions. A well-designed installation of this type also produces uniform illumination at such heights comparable both in quality and footcandle level to that at the floor. In this case, there was no appreciable variation in horizontal footcandles at working planes up to 18 feet above the floor or at different locations with respect to the twin rows of lighting units. This is due to the fact that the reduced number of luminaires contributing to the illumination level at the higher working position is approximately balanced by the increased light produced because those units are closer to the work plane. This consideration, plus the fact that the cool light from fluorescent sources becomes an additional advantage at the higher working positions, should enter the planning of all aircraft-plant lighting installations because of the possibility that transports or other larger types of planes may later be produced n such areas.



(Below) A general view in the assembly area of a huge bomber plant designed and constructed for the production of large four-engine bombers. The lighting system consists of thousands of two-lamp fluorescent units (200-watts over-all per unit) mounted in twin rows from steel beams on 25-foot centers and located 40 feet above the floor. The nominal spacing within each row of reflectors is 8 feet 4 inches along the truss and the nominal spacing lengthwise of the building is 12 feet 6 inches since two rows of units are used per beam. A recent check of the illumination level in the clear assembly area showed the average footcandle value to be 36.4 after the lamps had burned over 1500 hours on the average. The average vertical illumination based on measurements in each of the four cardinal directions was 20.5 footcandles under similar conditions, or over half the average horizontal level.

The illumination level is extremely uniform both in horizontal and vertical planes throughout the width of the assembly area and also in the lengthwise direction. This is particularly important where work positions vary to the extent found in the assembly of large aircraft.

There are several reasons why fluorescent lighting is particularly suited to aircraft assembly. In the first place, such systems provide excellent vertical illumination for the many visual tasks found at those angles. Too, employees frequently look upward and thus have much of the lighting system directly in their field of view, so low-brightness sources minimize direct glare and after-images. Most airplanes also present large specular surfaces before final painting (primer coats are frequently of glossy lacquer) and low-brightness sources are desirable to minimize reflected glare. Finally, the large area of the lighting units not only provides excellent visibility for machining operations but helps reduce shadows under wings, around engine assemblies and at similar work locations.

(Above) One of the low-bay machining areas in one of the large aircraft plants. Continuous rows of RLM fluorescent reflectors on 13½-foot centers produce 30 footcandles and excellent visibility. The victory "V" formed by the lighting system and the sign "Time Is Short" are symbolic of the war production effort to which this plant is dedicated.

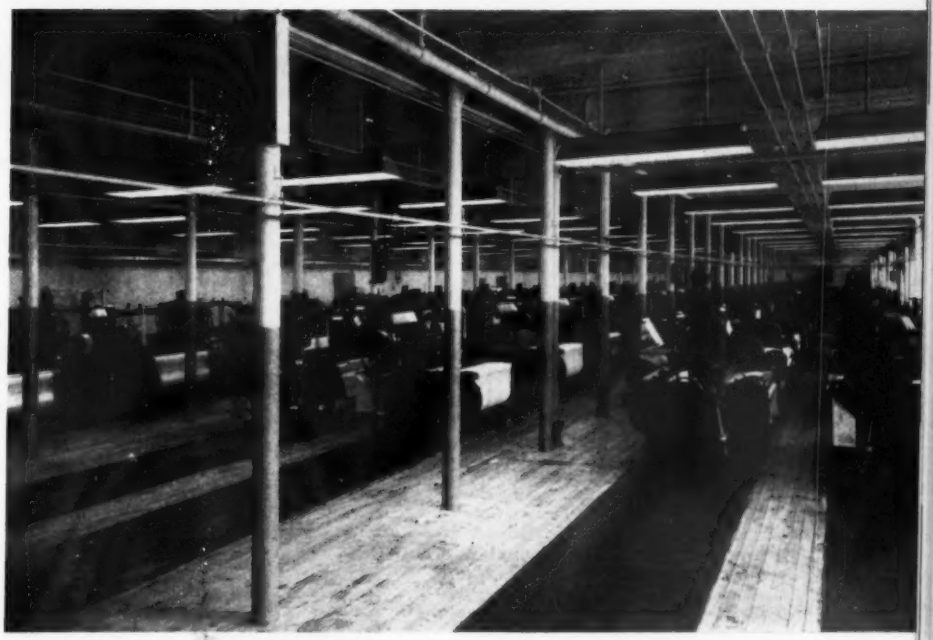
Photo courtesy Austin Company

Above, this view of a bronze and aluminum foundry in the East Central region, busy on a 24-hour-a-day schedule molding the weapons of war, illustrates lighting conditions wholly inadequate for nighttime operations. The installation consisted of old-style conical-shaped porcelain-enamelled reflectors on approximately 40 by 70-foot centers equipped with 750-watt filament lamps. The mounting height was from 45 to 60 feet above the floor and the illumination level in service was less than 2 footcandles. Localized lighting in the form of bare 200-watt clear-bulb lamps on drop cords was provided at locations involving critical seeing, but these lamps were directly in the field of view in many cases and produced severe direct glare.

Below, the new lighting installation at this same foundry was installed without interrupting essential production and consists of 3000-watt Mazda H (mercury) lamp units in porcelain-enamel steel reflectors located on nominal 35 by 40-foot centers. The illumination in service will be around 35 footcandles average at the working level. This light source (see article "Modern Lighting for Industry" in March, 1942, issue of *Electrical South*) was selected because it makes the higher illumination levels possible at the lowest over-all cost and with a minimum number of reflectors. Each reflector is equipped with a disconnecting hangar so that the unit can be lowered to the floor for cleaning and relamping.

Left, industrial fluorescent reflectors using two 40-watt lamps each produce good illumination in this worsted mill. The units are mounted 6 feet 10 inches above the floor and are on 6 ft. by 7 ft. centers. Initial illumination measurements showed 50 footcandles on the tables and 35 footcandles on the floor. Daylight lamps are employed.

Right, this view shows the fluorescent lighting installation in a rayon and silk weave room of an Eastern textile mill. Fluorescent lighting was chosen because the large area and low brightness of the sources tend to reduce specular reflection from the threads to a minimum. The system consists of 150 porcelain-enameled reflectors each equipped with two 100-watt white Mazda F lamps and mounted 10 feet above the floor on nominal 9 ft. by 10 ft. spacings. The average general illumination is 50 footcandles on the looms.

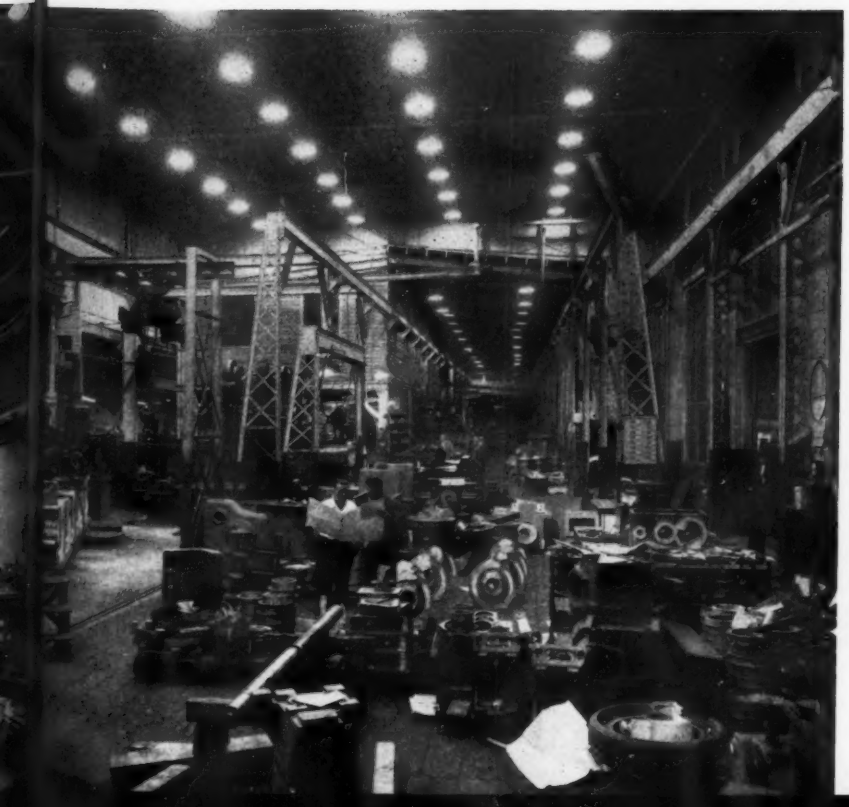


Left, an example of the way industrial fluorescent reflectors can be installed at individual outlets (rather than continuous rows) is found in this toolroom of a West Coast plant. Three-lamp reflectors are located on 8 ft. by 10 ft. centers and mounted 8 feet high. The initial illumination level (after 100 hours) was 55 footcandles which should settle to around 40 footcandles in service.

Above, in this high-bay industrial area, 400-watt H-1 Mazda H lamps in suitable reflectors are located on 10 ft. by 15 ft. spacings and mounted 38 feet above the floor. The average illumination level is 30-40 footcandles in service. Note that alternate reflectors have been omitted in the center row which is over the main aisle.

Right, this straight mercury installation in an East Central tool works provides around 60 footcandles of average illumination in service for the critical visual tasks performed. A total of 220 H-1 lamps light the 22,000 square foot area. The mounting height is 32 feet.

Above, a variety of reflecting equipment is available for the H-1 lamp. In this Middle-western pump company plant, such lamps are used in Glassteel Diffusers on a 13 ft. by 15 ft. spacing. The mounting height is 14 feet and the average illumination in service 30 footcandles.



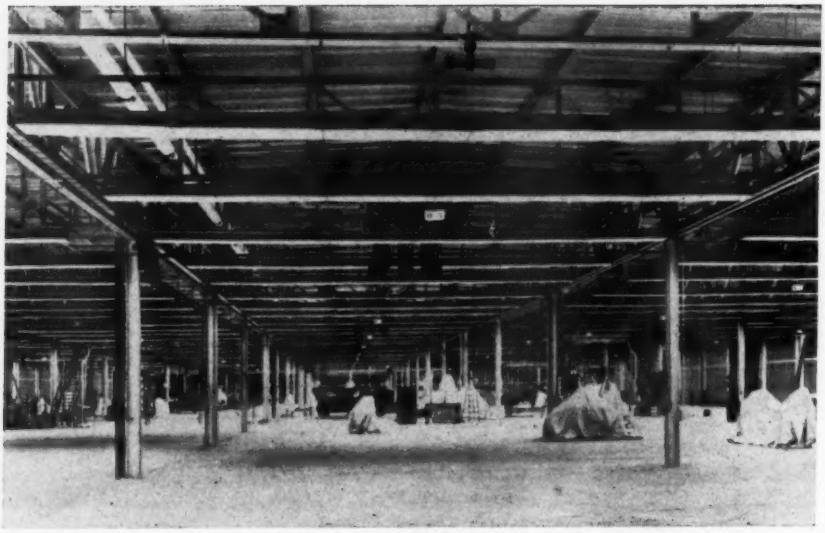
Left, this machine and erection shop is lighted to over 50 footcandles with 400-watt H-1 Mazda H lamps in high-bay reflectors located on 9 ft. by 9 ft. centers in the section shown at the front of the photograph and on 10 ft. centers in the rear portion. These lamps are receiving much factory-lighting consideration today because of their high over-all efficiency (over 35 lumens per watt), their life rating of 3000 hours, and their excellent lumen maintenance characteristics.

At left, a large East Central plant as it appeared before World War I. Shallow-dome reflectors with 100- to 200-watt lamps, spaced on outlets varying from 15 to 20 feet apart, produced around 3 footcandles in service.

Below, the same plant showing the remodeled lighting installed in 1922. Outlets were located on 10 ft. by 10 ft. and 10 ft. by 12 ft. centers: the former using 200-watt lamps in Glassteel diffusers and providing 13 footcandles in service; the latter using 300-watt lamps in similar equipment and producing 18 footcandles in service.

Below, the lighting in this same factory area was again remodeled early in 1942. Although the same outlets located in 1922 are employed, the illumination level was practically doubled by using two-lamp fluorescent units (200 watts over-all) with 35 footcandles in service resulting where the outlets are on 10 ft. by 10 ft. centers and around 30 footcandles where the spacing is 10 ft. by 12 ft. These three illustrations show increases in illumination throughout the years which have approximately followed the logarithmic scale of footcandle effectiveness in order to meet the more severe seeing requirements. This logarithmic principle is the result of many researches in the Science of Seeing and it now forms a quantitative skeleton for recommended footcandle tables.

Above, this former lighting installation in an Eastern textile mill shows the inadequacy of the illumination and the harmful direct glare produced by the bare lamps employed. Below, the present lighting installation in the same textile plant. Seventy Glassteel combination reflectors using one 400-watt Mazda H and three 150-watt incandescent lamps in each reflector provide 30 footcandles in service. The spacing is 12 ft. by 16 ft. and the mounting height is 11 ft. The total wattage per outlet is 880.

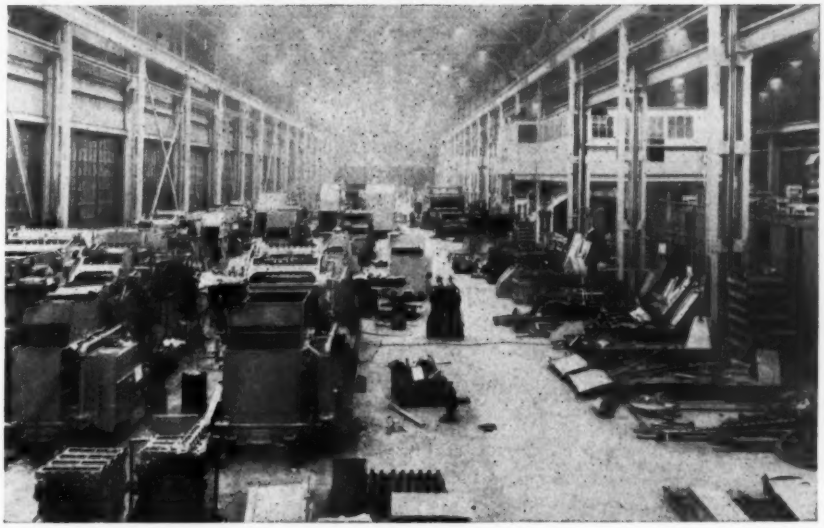


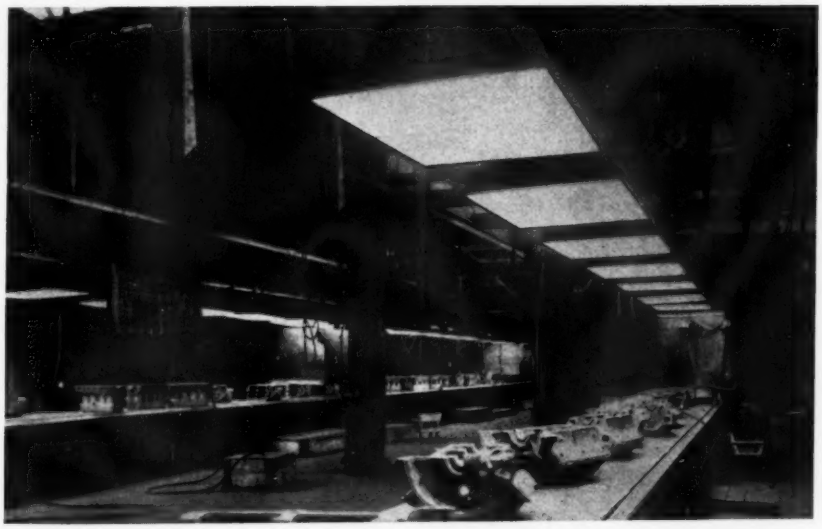
Left, this photograph shows the first continuous-row installation using the 100-watt Mazda F lamp. The rows of RLM units are 13 feet 4 inches apart and are mounted 15½ feet above the floor. The average general illumination is 50-60 footcandles.

Right, the war demand for experienced man power has necessitated the training of millions of people to operate the machines in new and enlarged factories. This photograph shows such a machine shop training area in an East Central high school. The two-lamp open-end industrial fluorescent reflectors provide 30 footcandles of comfortable seeing illumination.

Left, employees in this Eastern munitions plant have 25 footcandles in service from 2-lamp 40-watt fluorescent units on 8½ ft. by 9 ft. centers. The units are mounted 10 feet high.

Right, an alternate staggered system of H-1 and 750-watt filament lamps on 15 ft. by 20 ft. centers produced 30 footcandles in this large factory area. The mounting height is 36 feet.

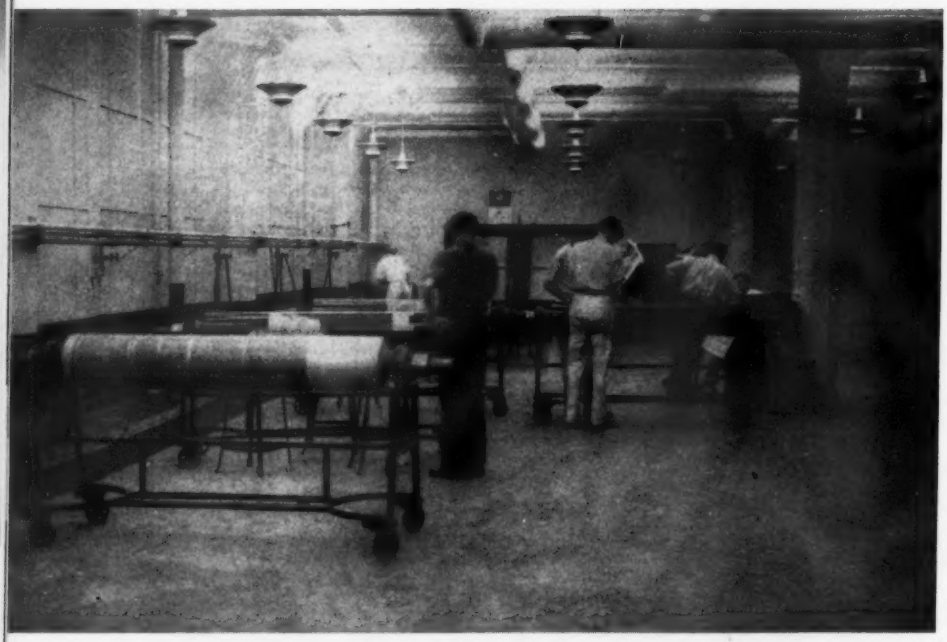




Left, a good localized-general lighting system is provided in this Michigan foundry by 40 Benjamin Skylight units mounted 50 inches over the conveyor and 18 inches apart. Around 55 footcandles of horizontal illumination results on the conveyor. Each unit employs a 200-watt lamp. The vertical illumination is also excellent, being a minimum of 30 footcandles in the direction of the conveyor travel.

Right, another alternate mercury system using thirty 400-watt H-1 units and ninety 200-watt filament units on 20 ft. by 20 ft. centers. The average illumination level is 22 footcandles in service. The plant is engaged in the manufacture of textile machinery.

This machine shop area in an aircraft factory is illuminated to 50 footcandles by an alternate system of H-1 Mazda H (mercury) and 500-watt filament lamps on 16-foot centers. Note that the filament and mercury units are near each other at the same outlet.

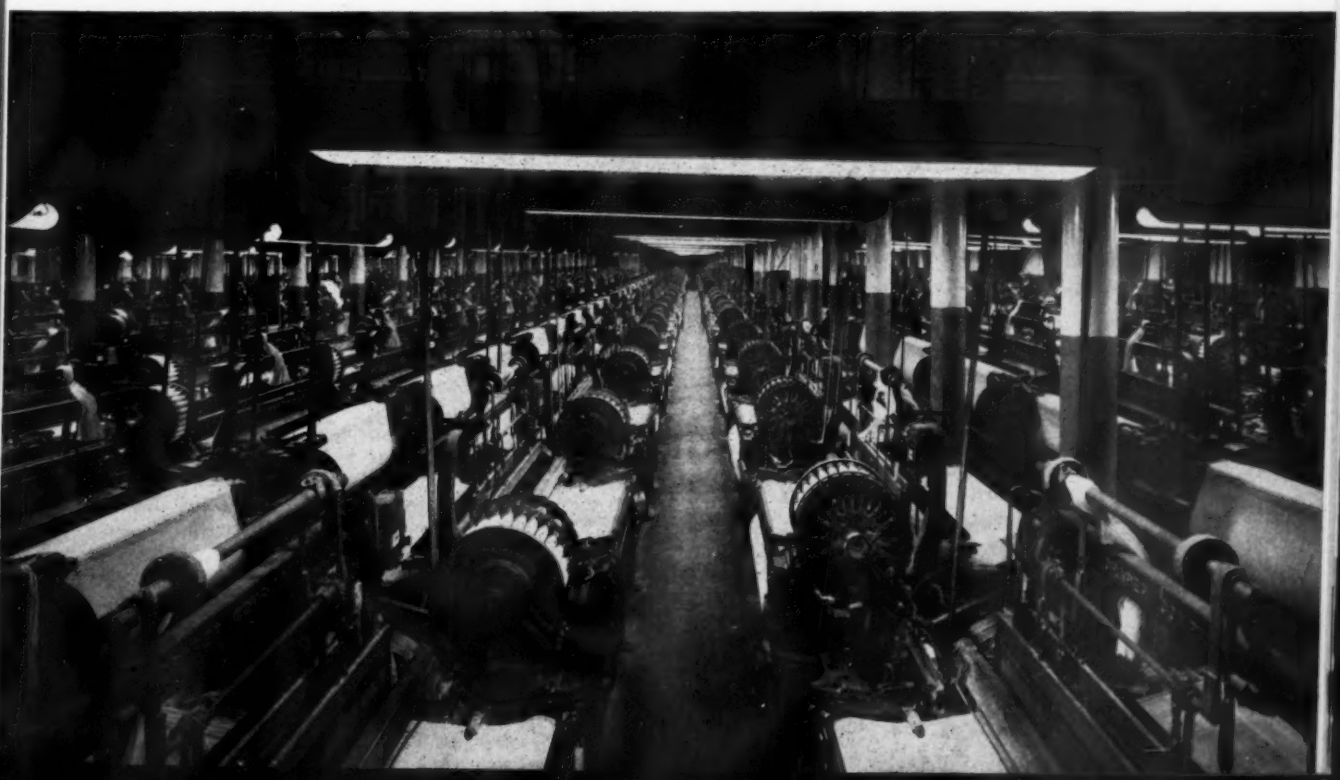


Even indirect lighting has its appropriate applications in industry. This installation of 500-watt lamps in totally indirect units on 10 ft. by 10 ft. centers provides 40 footcandles of comfortable illumination for the inspection of rotogravure printing rolls. The ceiling height is 12 feet.

A good filament-lighting installation in a textile plant is shown in this photograph. Glassteel diffusers with 750-watt lamps are located on 10 ft. by 12 ft. centers 12 feet above the floor. The illumination level is 35 to 40 footcandles in service.

Above, the former lighting system at a textile mill in the Southeast. The system consisted of 200-watt filament lamps in RLM dome reflectors mounted 11 feet high and on 16-foot centers over the weave aisle, or one lamp for each four looms. Since the weave aisles are 12 feet apart, the actual spacing was 12 ft. by 16 ft. and a relatively low level of illumination resulted. In addition, the use of small direct-lighting units produced harsh shadows of the operators and power beltings, aggravating the already difficult seeing tasks of checking cloth, finding broken threads, threading needles, loom fixing, etc.

Below, the new fluorescent lighting system at this same textile mill. Forty footcandles of comfortable illumination is provided on the woven cloth and essential parts of the loom by 500 single-lamp fluorescent units (100 watts over-all) mounted 8 feet high and on 8-foot centers over the weave aisle. Each reflector lights a pair of looms, the actual spacing being 8 ft. by 12 ft. The reflectors were mounted only 8 feet high not only for lighting considerations but also to be lower than the humidifier level, thus avoiding a spray of vapor on the lamps and reflecting surfaces. Even in the beam aisles, the illumination level is 20 to 25 footcandles which provides good seeing illumination for the tasks performed from that side of the loom. The large-area sources also minimize annoying shadows, and the soft shadows which do result are almost identical on all looms.



Smashing the Bottlenecks!

Material shortages will make it impractical to modernize lighting in all war production plants but lighting bottlenecks can be eliminated through these simple expedients.

By W. G. Darley*

IT IS COMMON knowledge that improved lighting conditions result in the increased production of a better quality product. And there is no question but that the lighting in the vast majority of plants engaged in war production in the country could stand considerable improvement. At the same time, material is not available for enough reflectors to improve the lighting by increasing the general illumination in every plant where improvement is needed. And even if the materials were available, there is not a sufficiently large group of trained lighting engineers or counsellors to make the lighting layouts. Therefore, the efforts of this group must be confined to those processes, departments, plants, and industries which are production bottlenecks.

In order to smash bottlenecks it is not always more light that is needed, but more knowledge—knowledge which lighting men have. It is, therefore, their wartime job to smash as many bottlenecks as hours in the day will permit. It has been estimated that if lighting could be improved throughout the nation, 600,000,000 man-hours a year would be added to the Victory effort. While, as has been indicated, it appears impossible to do the whole job at once, lets start with the bottlenecks and do our best, to put it mildly.

Common Dirt

Without a doubt, the narrowest bottleneck is the one which keeps light, for which management pays, from reaching the working surfaces. In many cases as little as one-half of the light which is paid for can be measured at the work plane (Fig. 1). This bottleneck is as old as lighting, and the amount

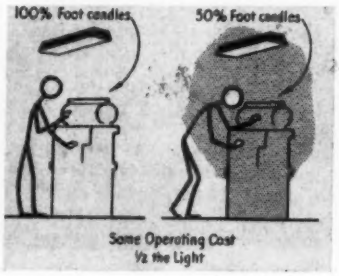


Fig. 1

of attention usually paid to it is in inverse proportion to its age. That is, this very old problem of "Common Dirt" receives very little attention in the average factory.

It has been conservatively estimated that if all of the lighting in the country were properly maintained (Figs. 2 and 3), the average illumintion in service would be doubled. Reflectors, lamps, and wall and ceiling reflecting surfaces are dirty; socket voltages are low for the nominal rating of the lamps used or too-high voltage lamps are used for the standard voltages; blackened lamps are continued in service far beyond their normal life, and burned-out lamps are not replaced promptly. These are some of the characteristics of poor maintenance which contribute to the tremendous waste of light.

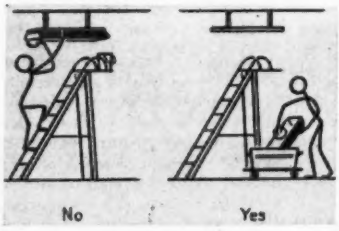


Fig. 2

Fig. 3

The objection to maintenance, of course, is that it costs money, and this is true. But it should be remembered that lighting costs money in terms of lamps and power as well, and when an inexpensive maintenance operation will produce 30% or more light for the same lamp and power costs, which are relatively much higher than the maintenance cost, it is good business to spend a little money on maintenance (Fig. 4).

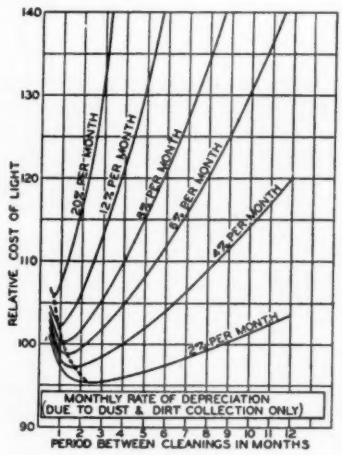


Fig. 4

In one textile mill, for instance, a regular cleaning program results in the average illumination therein being maintained between 50 and 55 footcandles while a haphazard maintenance program similar to that found in most factories would

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result in an average illumination of between 35 and 40 footcandles. In this case the plant management can afford to pay about one-third as much for the maintenance operation as is paid for the combined lamp and power cost since the maintenancce operation is producing an average of about 1/3 more light than would be obtained without it.

As a matter of fact, the cost of maintenance is not this great. The difference is an "actual saving" in operating cost since the plant standards call for 50 footcandles plus and if the results were not obtained by maintenance the lighting installation would have to be increased approximately one-third in order to achieve the desired result.

Poor maintenance is a lighting bottleneck which can be smashed by anyone equipped with a volt-meter, soap and water, and a light meter—the volt-meter to check the socket voltages under normal operating load conditions with a lamp operating in the socket being checked, the soap and water to clean lamps and reflectors, and the light meter to demonstrate to the plant management the difference between conditions as found and the results after the voltage is either corrected or the proper voltage lamp is installed and/or the lighting equipment cleaned.

Direct Glare

Probably the worst lighting-production bottleneck is the constriction of the pupils of the worker's eyes as a result of glare. While we cannot see without brightness, when brightnesses are too high they are not only uncomfortable but may actually reduce one's ability to see fine detail. Glare is often popularly called negative light because "the more you have the less you see." The sensation of glare is influenced by numerous factors, some of which are given below.

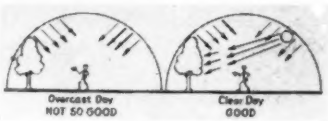


Fig. 5

The ratio of footcandles on the work to footcandles at the eye is probably one of the most influential factors. There should always be more light on the work than at the eyes if possible. The more desirable ratios of footcandles at the eye (as it views the work) to footcandles on the work are of the order of 1 to 5. For instance, with the sun behind an observer outdoors (Fig. 5), the ratio of the footcandles on the plane of the eyes

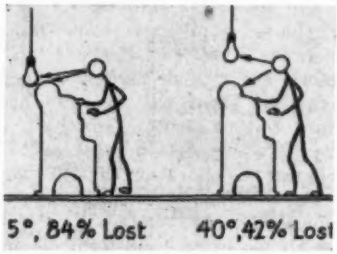


Fig. 6 Fig. 7

to the footcandles on the object is generally of the order of 1 to 5 and becomes even smaller as the eyes are directed more and more below the horizontal.

The position of the glare source in the field of view is tremendously important. For instance (Figs. 6 and 7) with a bare filament lamp within 5° of the line of vision, the

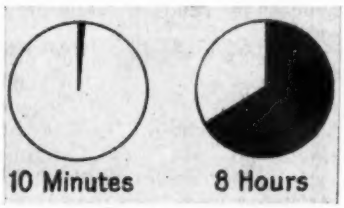


Fig. 8

light on the object to be seen may be only 16% effective. Even when the glare source is 40° from the line of vision, the light on the work may be only 60% effective. Values of this order have been determined by actual measurements of visibility. As a matter of fact, however, discomfort begins to be noticeable, as a rule, long before actual reductions in visibility take place.

The brightness of the glare source also influences the sensation of glare. Naturally, if a source fixed in position is made brighter, it will become more glaring. The fact that glare varies directly with size means that the further away or higher up glare source of fixed brightness and size is placed, the less glaring it is.

Whether or not a condition is glaring also depends upon the time which the observer is subjected to the offending brightness (Fig. 8). Brightnesses which might be tolereable in a factory, for example, where the worker is not "tied down" to one position by a desk and chair, might be quite glaring in an office where the worker spends most of the day facing in one direction with his visual field limited.

Suggested remedies for some of the common causes of direct glare are given below.

Properly designed reflectors should be used. The standardized shielding angles for distributing types of industrial equipments for Mazda C lamps is 17½° (to lamp filament), for Mazda F lamps 13° (to edge of lamp). Clear Mazda C lamps in open reflectors should only be used at mounting heights of 20 feet or more, or out of the normal line of vision. At lower mounting heights, these brightenesses can be reduced with diffusing materials or equipments such as bowl-enameled lamps, the opal globe on the glassteel diffuser, and diffusing rings.

The glare effect can also be reduced by increasing the brightness of the room without increasing the brightness of the source, i. e., by increasing footcandles. This method is particularly applicable to lighting with Mazda F lamps (Fig. 9) since the brightness of the source is not increased when footcandles are increased, as is usually the case when Mazda C lamps are used.

Fig. 9

The glare effect can also be reduced by extending the area of the light source and reducing its brightness. Thus a condition which is glaring with Mazda C lamp equipment might be made quite satisfactory at the same footcandle level with Mazda F lamp equipment (Fig. 10).

Fig. 10

Fig. 11

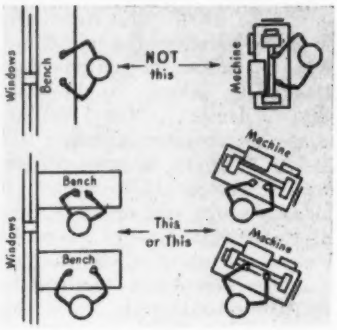


Fig. 12

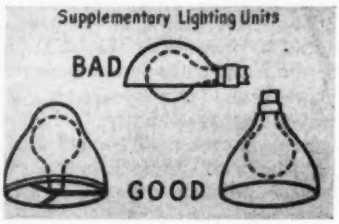


Fig. 13

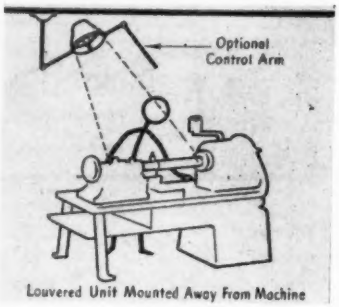


Fig. 14

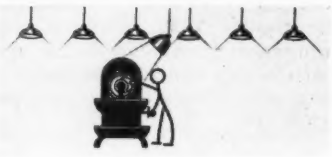


Fig. 15

Fig. 16

Natural lighting can also cause glare. Shades or venetian blinds should be used to control brightnesses seen or coming through windows. Painting areas adjacent to windows with light finishes will help some (Fig. 11).

In many cases difficulty is experienced with glare from windows because work benches are placed along the wall or machines are located so that the operator must face the windows. The best and possibly simplest answer is to so change the operation that the workman does not have to face the window (Fig. 12).

All too often local lighting units are so shallow that they allow the lamp to shine in the eyes of the operator using them and even more often in the eyes of operators at other machines. Well-designed louvered supplementary lighting units for filament lamps are available (Fig. 13). An excellent practice is to locate these units on adjustable arms at the ceiling and aim them at the work area (Fig. 14). They are up where they are not glaring and are not constantly handled by hands which generally are dirty.

From this discussion of direct glare, it is obvious that low brightnesses in the direct-glare zone are highly desirable. The suggested limitations are: (1) minimum ratio of footcandles at eye to footcandles on work, 1 to 10; (2) maximum range of brightnesses in field of view, 10 to 1.

Need for Vertical Illumination

In most machine shops the need for vertical illumination at the work point has made it impracticable to have as low a ratio of footcandles at the eye to footcandles on the work as can be achieved with ease today. Therefore, the importance of having the brightness of the light source as low as possible, by increasing its size or area, becomes paramount if glare is to be kept within reasonable limits.

One solution for some plants may be to have high levels of general lighting without a high vertical component and to supply the vertical illumination required from well-shielded supplementary lighting units (Fig. 15). Another way would be to face all of the workmen in one direction with a lighting system designed (by tilting the reflectors, for instance) so that the predominant direction of the illumination is in the direction faced by the operators with little light toward their eyes (Fig. 16).

A high brightness contrast between a light source and its background creates or intensifies the direct glare effect. For instance, poorly adjusted automobile headlights may hardly be noticed when turned on in the daytime, but become quite glaring at night (Fig. 17).

In the factory, the use of supplementary lighting may create a glare effect if there is not enough general lighting in the room. This is because the contrast between the brightness of the work and that of the surroundings is too high (Fig. 18). The same glare effect is created when the operator works on light or bright materials and the immediate background is quite dark. Good general lighting and light machines and work places provide the answer. In the office, light desk tops are recommended instead of the dark ones commonly found.

While for greatest seeing ease, the brightness of the surroundings and that of the object viewed should be the same, there is some advantage in having the work somewhat brighter than its immediate surroundings in order that it will make an appeal for the voluntary attention of the worker. This differential, however, should not exceed 5 to 1, and a half of this value is probably more nearly the correct one (Fig. 19). If possible, as previously mentioned, the brightness ratio for adjacent areas in the visual field should not exceed 10 to 1.

Contrast can, of course, be achieved by means of paint. Thus

Fig. 17

Fig. 18

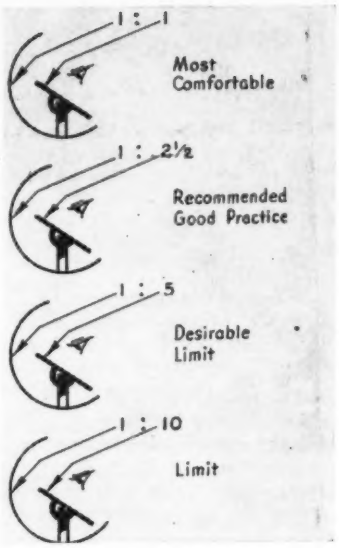


Fig. 19

color contrast becomes one of the tools of the lighting man and his complete recommendations for seeing will cover the color of the various machine surfaces. Semi-glass, oil-resistant, washable machinery paints are available in light colors and can be applied to advantage to the entire machine with the exception of some of the working parts. One very practical scheme is to paint the machine a medium gray with light buff around the working area (Fig. 20).

The combination of brightness and color contrasts has several advantages: (1) soft contrasts are easier on the eyes than abrupt changes in brightness; (2) making the tool area slightly lighter does tend to concentrate the attention on the work; (3) a favorable contrast can be used to highlight danger; (4) the controlled color contrasts give a three-dimensional effect which causes the work in machines so treated to stand out in stereoscopic clearness that cannot be achieved with brightness contrast alone.

The basic requirement for satisfactory brightness conditions in the factory is a good layout for general lighting.

Reflected Glare

Reflected glare can be more objectionable and harmful than direct glare since it may come directly from the object the workman is trying to see, and because it is generally from a direction below the horizontal, a zone in which the eye has no natural protection. Furthermore, the eye is often subjected to it for long periods of time.

Reflected glare is caused by the reflection of light sources in specular, spread and glossy surfaces. Examples of surfaces which cause reflected glare are "bright work" on machines and glass tops on desks. Quite often such surfaces can be given a non-specular finish or entirely eliminated. The intensity of the reflected glare is also a function of the brightness of the source; therefore, the brightness of light sources, as seen from the work (Fig. 21), should be as low as practicable.

For work on material which gives a "spread" reflection, as in a machine shop, brightnesses as high as 25,000 footlamberts (50 or 10 candles per square inch) toward the work may not cause obvious reflected glare where the illumination is 50 footcandles or more. For work on highly polished sheet metal, the brightness in the work's-eye view should not exceed a value in the neighborhood of 500 footlamberts. In offices and drafting rooms, brightness as "seen by the work" of 2000-2500 footlamberts may be satisfactory when the illumination is at least 50 footcandles.

Specular reflection of a local nature may be prevented by locating the light source in such a position with respect to the work that the specularly reflected brightness will be away from rather than toward the eyes (Fig. 22).

Shadow Problems

Annoying shadows may be the result of the position of the main light source with respect to an object or person, or the natural result of the use of small light sources. Particularly with filament lighting we find that shadows are harsh and often fall across the tool point (Fig. 23). This problem can often be solved simply by relocating the overhead lighting units (Fig. 24) or by the addition of supplementary lighting at the tool point. In some cases, however, it may be necessary to replace concentrated light sources with large-area sources to do the kind of a job which must be done. (Fig 25.)

The use of the fluorescent lamp has introduced a new type of shadow problem, in the drafting room particularly. When a line light source and a straight edge are parallel, the shadow of the straight edge is quite sharp. Such a shadow makes it difficult to bring the straight edge up to faint lines since when the faint line coincides

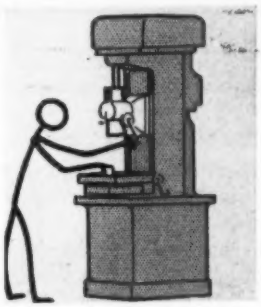


Fig. 20

Fig. 21

Fig. 22

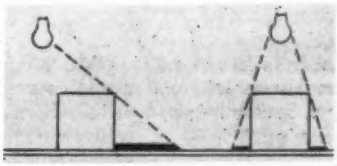


Fig. 23

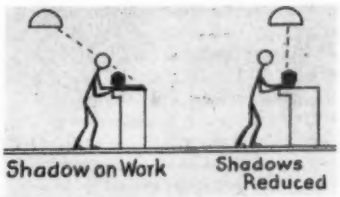


Fig. 24

Fig. 25

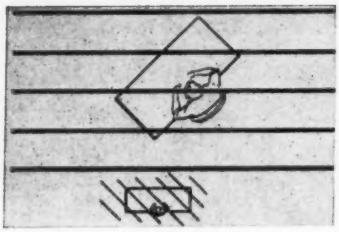


Fig. 26

with the sharp edge of the shadow, the line has a tendency to disappear. The solution to this problem in the drafting room, for instance, is to turn boards or lighting units so that straight edges are parallel to the light sources for but a small part of the work (Fig. 26). The exact angle of rotation is not established; however, 45° is often suggested for structural and aesthetic reasons. While this angle will result in shadows on the board from triangles, etc., at one of the 45° angles, this ordinarily represents but a small fraction of the draftsman's work.

Special Problems

There are any number of seeing problems which require high footcandle values or special treatment which are neither easily nor economically provided by a standard general lighting method alone. Such production bottlenecks can only be solved by special lighting on the production line. In general, such specialized lighting will merely supplement the general lighting which furnishes working footcandles over large areas, helps to relieve harsh, annoying brightness contrasts and provides conditions of safety by means of quick and easy seeing.

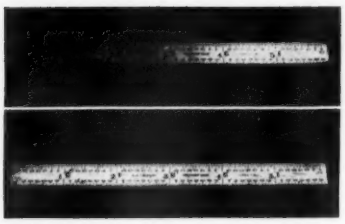


Fig. 29-a. (Top). Appearance of steel rule under a typical general system of industrial reflectors. Fig. 29-b. (Bottom). Appearance of steel rule under a source of large area and low brightness.

There are two types of supplementary lighting equipment which will take care of most special requirements: (1) small, relatively concentrating units which are intended to augment the general lighting over restricted areas and to provide *directional* lighting, and (2) large-area, low-brightness diffuse light sources which may serve either as the general lighting system for small areas, or as supplementary sources for "plus" lighting. Examples of these two types are shown in Fig. 27.

Diffuse lighting makes all the difference between sure and easy seeing and doubtful seeing when it is necessary for the workmen to read the figures on polished micrometer calipers, scales, feed-indicating dials, etc., as is shown in Figs. 28 and 29. Thus large-area low-brightness sources are desirable for the majority of machine tool operations to improve the visibility of these items. At the same time, tungsten-filament lamps in concentrating reflectors are often necessary to provide a directional component for such work as boring

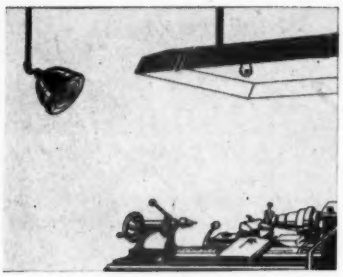


Fig. 30

operations. While there are suitable units to do this job which can be located on the machine, directional units are available which can be located out of the way of the workmen and away from careless handling by being mounted at the ceiling, on sidewalls or columns, or suspended 4 to 5 feet away from the work on conduit (Fig. 30; also see Fig. 14).

While a large-area unit above the machine (Fig. 30), usually does a good job on most of the dials, there are some dials which are not so located or tipped as to reflect the light source to the workers' eyes. In such cases improved visibility can usually be obtained by installing a small light-colored reflecting surface adjacent to the scale and at a 45-degree angle with the horizontal (Fig. 31). The reflection of this white background in the surface of the scale makes it easy to see the numerals and divisions. A matte surface of high reflectivity, which is durable and easily maintained, is most satisfactory.

The use of continuous-row fluorescent general lighting in the factory, installed at right angles to the axis of the dials, can be as

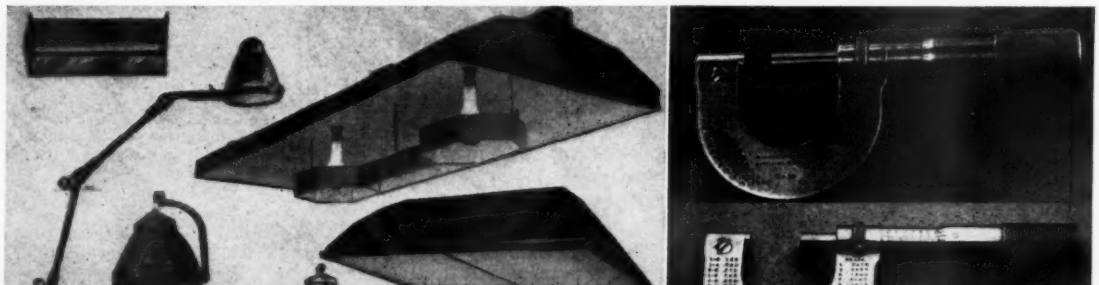


Fig. 27. (Left). Fig. 28-a. (Right top) Appearance of micrometer caliper when viewed under a typical general system of industrial reflectors. Fig. 28-b. (Right bottom). Appearance of micrometer caliper when lighted by a source of large area and low brightness.

effective for dial lighting as supplementary large-area units (Fig. 32).

Bench Work

Bench work and assembly operations require a high level of good-quality illumination which, in general, can best be supplied by large-area equipment (Fig. 33). These, of course, include industrial reflectors for Mazda F lamps. Each job requires analysis to meet specific requirements. In some instances dual facilities must be provided: (1) diffuse lighting for certain defects, (2) directional lighting producing "glint" or casting shadows which may be essential to reveal others.

Hangars and Garages

Portable repair standards equipped with special lighting can be used to good advantage in airplane hangars and garages. The unit shown in Fig. 34 consists of 5 angle reflectors mounted on a portable rack with outlets for electrical tools. Two-hundred watt Mazda C lamps are recommended. The usual extension cord equipped with a 50 or 100-watt Rough Service Mazda lamp in a suitable guard is provided for internal inspection. Extension units utilizing the small Mazda F lamps are also available.

Vertical Surfaces

Angle reflectors can also be used to supplement the general overhead lighting and to build up the lighting on vertical surfaces along assembly lines. Special care is necessary in locating and shielding the units to avoid their becoming glare sources to workers who face toward the units. For fairly uniform lighting along a vertical surface, the spacing between units should not exceed 1-1/2 times their distance out from the lighted surface. Continuous rows of suitable reflectors housing Mazda F lamps provide an excellent solution to this problem (Fig. 35).

Dangerous Atmospheres

In moisture-laden atmospheres, such as steam processing, engine rooms, shower baths, also where gases and vapors are present from such processes as oil-spraying, paint and varnish making, and spray lacquer painting, vapor-proof, explosion-proof and dust-tight equipments are recommended. Mandatory requirements are covered in the National Electrical Code. Fig. 36 shows the application of vapor-proof equipment in a spray paint booth.

Quite often the exercise of a bit more than ordinary ingenuity is required to smash lighting bottlenecks at hard-to-get-at spots. Figs. 37 to 41 (inclusive) show some of the production bottlenecks which have been eased in this way. In all such cases the lighting man should first find out what the worker is looking at or for (which often is not what the worker thinks it is), then try to get light on the job without disturbing the process. However, the lighting man should not hesitate to recommend changes in processes if better seeing results will result thereby.

Tough Inspection Problems

Difficult inspection problems can often result in a bottleneck in the achievement of the highest quality product reaching the consumer. Unquestionably considerable customer good will is won when it is not necessary for him to return parts rejected because of flaws which should have been caught by the manufacturer's inspectors. Naturally this also *saves time.*

Color Problems

Many inspection problems require color discrimination, and for these it is frequently desirable to provide a color quality of light resembling daylight. For this service, the new daylight Mazda F (fluorescent) lamp is an excellent source. This lamp has a color temperature of approximately 6500° K., which is the standard for white light established by the National Bureau of Standards.

Color discrimination and color matching can also be accomplished by filters which, when used with Mazda C (filament) lamps, produce light of any desired color quality.

Color matching of lacquers, baked enamels, and similar materials with glossy surfaces can be readily accomplished by means of the booth shown in Fig. 42. The samples to be checked are supported on runners so that only the darkened area of the booth can be seen specularly reflected in the samples. Since the brightness of this area is extremely low, the specular reflection which overlays the true color of the sample is reduced to a minimum. The inspector stands fairly close to the inclined shield which cuts off any direct view of the light source itself.

While there are many glossy sur-

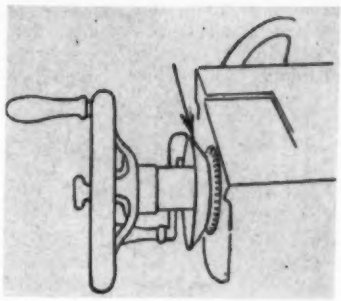


Fig. 31

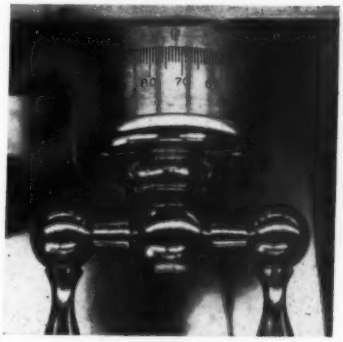


Fig. 32. Cross-feed micrometer collar of a lathe lighted by a source of large area and low brightness.

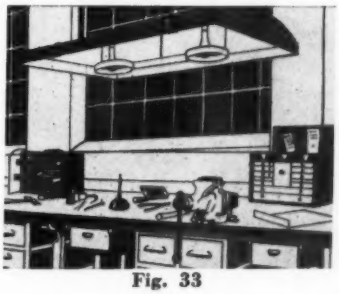


Fig. 33

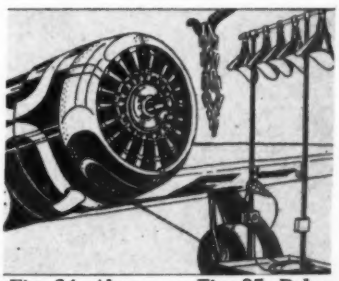
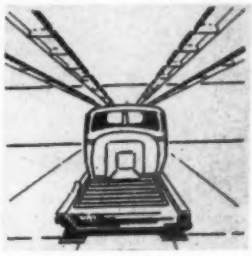


Fig. 34, Above. Fig. 35, Below



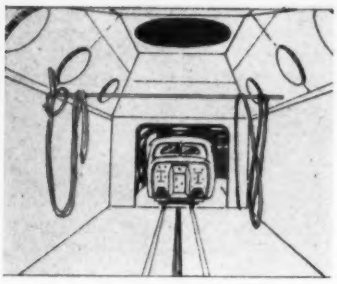


Fig. 36

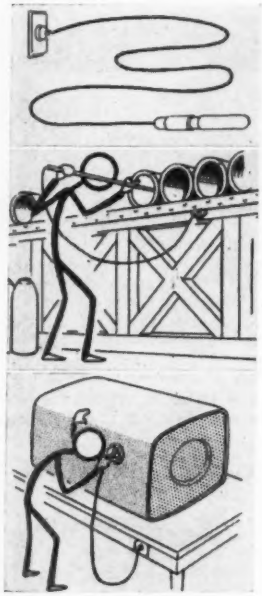


Fig. 37. Some production bottlenecks can frequently be solved by a little ingenuity with special lighting tools. Inspection of shell interiors or tank linings can frequently be aided by the use of special lamps on extension rods. The 25- or 40-watt T-10 Mazda lamp mounted on a rod is very useful to aid in seeing the interior finish of large shells.

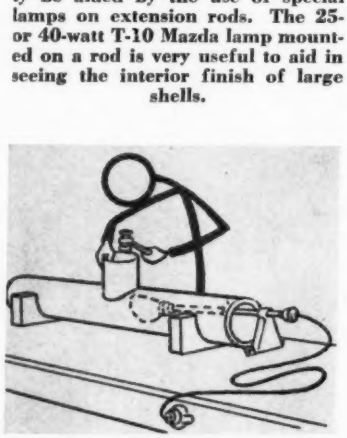


Fig. 38. Some seeing tasks require special adaption of lighting equipment. Inspecting internal parts of complicated assemblies can be helped by special brackets which place small lamps at the spot where they will do the most good.

faces which need to be matched for color, (and so require considerable care in the design of the inspection unit), for the majority of such jobs specular reflections are not a problem and the color-matching units may simply be mounted over the work area (Fig. 43). Such applications are for tobacco-grading, in dye houses, textile plants, etc.

Polished and Transmitting Materials

Large-area low-brightness light sources are prescribed for work with both polished and transmitting materials. When working with and inspecting polished materials, such as chrome and tin plate, aluminum sheet and plated or highly polished parts, the work is best seen by the use of the large-area uniform-brightness light source so located that its reflections can be seen in the work (Fig. 44). This means that the reflected image of the light source must be large enough to cover the area being inspected and that its brightness must be uniform and low so that the inspector can comfortably, and without glare, look into the bright area for flaws and color differences.

Where the flaws to be found are surface imperfections, waves, dents, dings—occurring in highly-polished surfaces, or refractive errors in clear transmitting materials, the source should have black bands or concentric circles placed on its surface. The images of the black bands or circles are seen in the polished surface or transmitted through the glass. As the head or the material is moved, distortions in these black bands or circles indicate flaws (Figs. 45 and 46). Scratch marks and flaws in the grinding and polishing of the metal preparatory to plating show up as small hair-line distortions or waviness in the edges of the reflected bands.

Fig. 39. Low-brightness, large-area light targets help to inspect gun barrels, tubing, etc. Sighting lines on the lighted surface helps to locate defects and irregularities in polished tubes, by providing reflection patterns.

Fig. 41. On repetitive operations on close-seeing tasks, the use of a fixed-in-place magnifier will sometimes relieve eye-strain, increase speed and accuracy.

Small fire cracks in glass jars, small bubbles in the glass, and pinpoint bubbles caused by foreign material in carbonated beverages need bright directional light sources. All of these defects act as small mirrors and sparkle as the object being inspected passes in front of the light sources.

The use of polarized light permits the easy detection of internal strains in glass, mounted lenses, lamp bulbs, radio tubes, transparent plastics, etc. The strained areas appear as color fringes when viewed by polarized light.

Fabrics

Large-area sources of uniformly low brightness are also valuable for the inspection of open-weave fabrics. They are also useful for the location and removal of any defects in open-weave fabrics previous to the final finishing process. The fabric is drawn across the source (panel), and the defects are seen by silhouette.

Matte-Finished Materials

Quite often the use of general diffuse lighting for the inspection of non-specular or matte materials actually obscures defects. Surface flaws, irregularities in surface

Fig. 40. Where extension cord lamps are required, the breakage factor may prove a decided bottleneck. Special Rough Service Mazda lamps have been designed for this service

shape, pit marks, scratches, and cracks in such materials are most easily seen by lighting which strikes the surface obliquely, casting a shadow and revealing the irregularities by shadow contrast.

In this manner, wrinkles in some roofing materials are revealed by small shadows which result from small directional units. Directional light has also been found most useful for the inspection of sandpaper and Venetian blinds.

Where work is done on parts so small that careful inspection can be made only by magnifying them (see Fig. 41), the work is greatly simplified by projecting the magnified image of the object onto a screen.

Moving Parts

Many times it is highly important to inspect and study moving parts while they are in motion. This can be done with stroboscopic lighting which can be used to "stop" or "slow up" the motions of constant-speed rotating and reciprocating machines.

Many substances fluoresce or glow with characteristic colors when exposed to ultraviolet radiation. Falling between the wavelengths of 2000 A. and 4000 A. are three important bands of ultraviolet that can be produced by commercially available equipment today. While fluorescent effects are obtained over the complete range, the band known popularly as "black light," centering around 3650 A., probably has the most potential uses for inspecting materials. Under this radiation, for example, many oils, analine dyes, and organic and inorganic substances fluoresce. Use is even being made of a fluorescent powder to disclose fine surface imperfections by wiping the surface with it, then exposing the surface to black light.

Few of the lighting problems described in these pages are new to trained lighting men but the glare, shadows, reflections and contrasts they cause are the bottlenecks wasting precious time in war production plants. Search out every lighting bottleneck in every war production plant and apply these simple remedies!

●

Inspection need not be confined to surfaces since the X-ray makes it possible to detect foreign objects or flaws in opaque materials. Examples are the detection of metal in rubber and the inspection of castings for flaws. Portable equipments for fluorscopic and plate inspection are doing much to speed the adoption of this type of examination.

From the foregoing it is obvious that the lighting man needs to get into the habit of thinking in terms of smashing bottlenecks. As a matter of fact, industrial lighting is rapidly leaving behind the days when the answer was "10x10x10," irrespective of what was going on below. Today it is a field in which imagination is required to do the job. Each problem is a thing which should be studied and the *right* solution recommended. By doing this for all customers, small as well as large, lighting men will not only be helping to increase production by breaking the bottlenecks, but can feel with pride and satisfaction that they are helping with a certain neck-breaking job in which we are all very busily engaged.

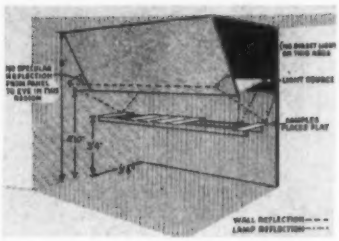


Fig. 42

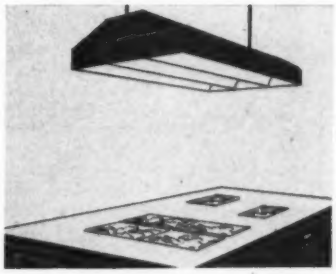


Fig. 43

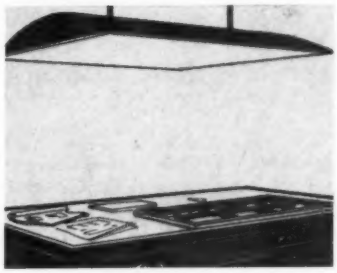


Fig. 44

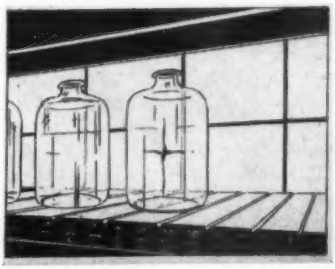


Fig. 46

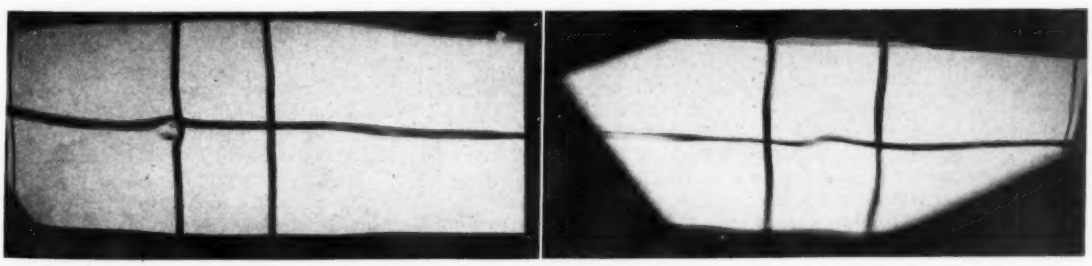
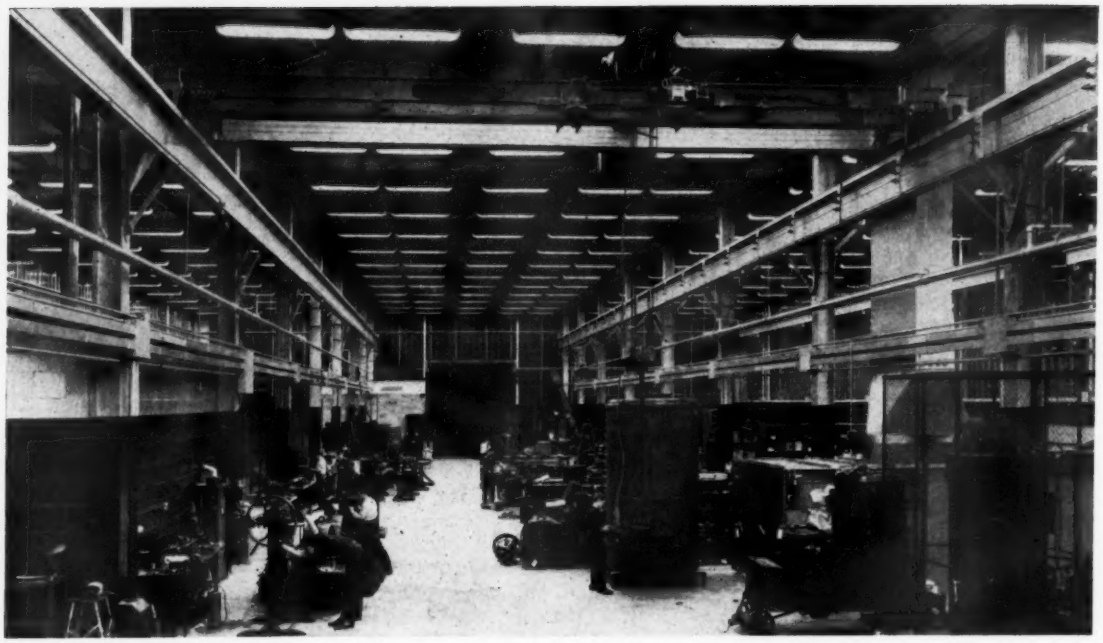


Fig. 45-a. (Top). Whorls or distortions in the reflected black strip help to locate the small dents and dings in polished surfaces. Fig. 45-b. (Bottom). Irregularities in contour, such as may occur in any flat glossy surface, can be detected by the wavy appearance of the black strip reflected in it.



PLANNING FOR INDUSTRIAL

Lighting Maintenance

By W. H. Kahler*

MATERIAL conservation is one of the duties of every man on the battle line of production. We must not waste any raw material or finished apparatus by neglect or carelessness. Therefore, it is essential to take care of all plant apparatus to minimize requirements for replacements and renewal parts.

A lighting system will last many years if it is properly maintained. In the preceding article of this series, we discussed the importance of a regular maintenance schedule to obtain maximum illumination efficiency and this subject is again covered in another article in this issue. The principal subject of this article deals with the various causes of mechanical and electrical troubles that might occur with the lighting systems of war production plants.

Like break-downs of any plant apparatus, most trouble with lighting equipment can be avoided if proper steps for prevention are taken. By understanding the causes of possible trouble, it is usually easy for maintenance electricians and foremen to spot trouble sources before equipment fails and requires replacement.

Filament Lamp Luminaires

Most large size Mazda C filament lamps have an average rated life of 750 or 1,000 hours. The rating is based upon the lamp operating at rated voltage and under controlled laboratory conditions. If short lamp life is encountered in-service, the cause may be:

1. **Voltage above rating**
2. **Severe vibration**
3. **Breakage by external causes**

As line voltage increases, efficiency and lumen output increase, but life is considerably reduced. (See Fig. 1.) If line voltage is found to be too high, it should be reduced or lamps with a higher voltage rating should be used.

Low voltage, of course, increases lamp life, but considerably reduces lumen output. Where low voltage is found, the line voltage should be increased or lamps with lower voltage rating should be used. Remember, lamps are designed to operate at a certain rated voltage because at this point light is produced at the lowest cost with average power rates.

Vibration is Detrimental

Vibration is more detrimental to the life of filament lamps than it is to mercury or fluorescent lamps. Where lamp life is reduced by a vibrating condition, life may be prolonged by:

1. **Suspending luminaires from shock absorbing hangers that dampen out the vibrations.**
2. **Using shock absorbing sockets.**

*This is the third of a series of articles by Mr. Kahler, of the Westinghouse Electric & Mfg. Co., Edgewater Park, Cleveland, Ohio. The first and second articles appeared in the July and August issues of Electrical South.

Lamp failure due to bulb breakage in service is very infrequent unless some foreign object or substance comes in contact with the bulb. If frequent breakages occur, inspect the luminaire and its surroundings. One of the following causes may be the reason for failure:

1. Lamp bulb touching a metal part of the luminaire, thus conducting heat away from the bulb rapidly at one point and creating a strain in the glass.

2. Drops of moisture striking the bulb. All lamps should be protected from rain or indoor moisture by providing enclosed luminaires.

Mercury Lamp Equipment

The luminaires for mercury lamps are very similar to filament lamp units, but the mercury lamp, itself, has very different characteristics. This lamp is essentially an arc source and must be operated from a specially designed high reactance transformer which furnishes proper starting voltage and limits the operating current. This current limiting device, or ballast, is necessary because an arc lamp does not have the ability to control its own current and, without the ballast, the current would quickly increase until the lamp burned up.

Both single and two-lamp transformers are in use today. (See Figs. 2 and 3.) Very little trouble is encountered with these transformers when the following operating rules are observed:

1. Be sure that line is connected to the transformer tap which is closest to the actual line voltage measured when luminaires are operating.

2. Be sure that the frequency rating of the transformer agrees with the power supply frequency.

3. Avoid locating transformers where the surrounding air temperature exceeds 105°F. (40° C.). Continued air temperatures over 105° F. may reduce the useful life of the transformer by breaking down the insulation. Where high ceiling temperatures exist, transformers should be located on the wall close to the floor where the air is cooler.

4. Connect transformers to a line where momentary voltage dips do not exceed 10%. A voltage drop of more than 10% below connected tap voltage may

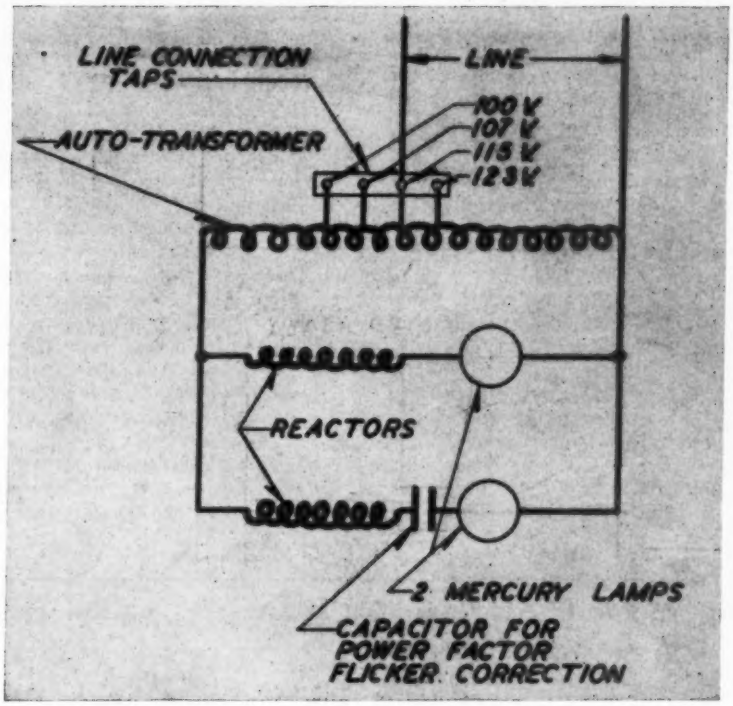
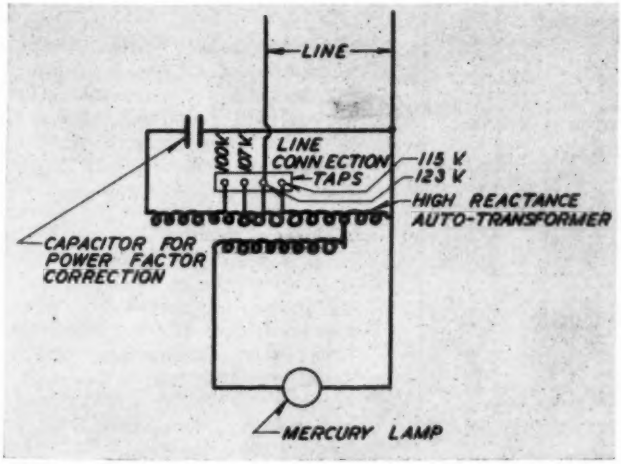
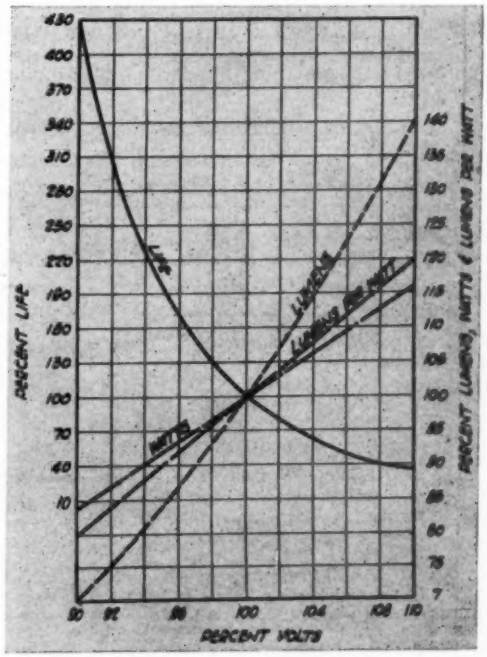


Fig. 3. Circuit diagram for a two-lamp mercury transformer.

Fig. 1. Operating characteristics of filament lamps. (Right)

Fig. 2. Circuit diagram for a single mercury lamp transformer.





cause some lamps to go out. Severe dips may be found in the heavy duty industries where large machinery or electric arc furnaces are suddenly thrown onto the line.

Mercury Lamp Life

The life of mercury lamps is dependent upon line voltage and the number of times the lamp is started. Line voltage that is too high or too low will reduce life. This is different than the case of filament lamps where high voltage reduces life, but low voltage prolongs life.

Every time a lamp is started, a small amount of electron emitting material is bombarded from the lamp electrodes. After many, many starts, all of this material is used up and the lamp is unable to start. With this fact in mind, one can readily realize that frequent starting reduces lamp life while only occasional starting prolongs life.

Unlike filament lamps, vibration does not materially affect the life of mercury lamps.

The operating position of some mercury lamps is critical. The 400-watt lamp should only be burned base up or base down. If this lamp is tilted more than 10° from vertical, the arc will bow, touch the bulb, and cause failure. The 100-watt and 250-watt sizes may be operated safely in any position if luminaires are properly designed.

Low ambient temperature has practically no effect on the operation or life of 400-watt mercury lamps. However, the 250-watt H-2 lamp may refuse to start at temperatures below 40° F.

Fluorescent Luminaires

Fluorescent luminaires are more complex than filament or mercury lamp equipment, but the understanding of a few simple rules and principles of operation will enable plant and building electricians to easily render the necessary maintenance to the lighting system.

The fluorescent lamp, like the mercury lamp is fundamentally an arc source. The main difference between these two illuminants is that the arc produces the visible light in the mercury lamp while in the fluorescent lamp the arc activates a fluorescent material that emits visible radiations. Since they are both arc sources, the fluorescent lamp requires fundamentally the same type of auxiliary equipment to provide proper starting voltage and to limit the operating current. In addition, the fluorescent lamp requires a mechanism known as a "starter" for momentary preheating of the lamp electrodes before the lamp starts.

The standard circuits for operating one or two lamps are shown in Figures 4 and 5 with the necessary component parts. For three lamp units, one single and one double circuit is used. For four lamp units two double circuits are employed.

The single lamp circuit operates in two steps when line voltage is applied.

First, the glow starter closes and allows current to flow through the lamp electrodes, thus preheating them.

Second, the starter switch opens after one or two seconds and a high voltage surge from the ballast starts normal lamp operation. If the arc fails to strike, the cycle is repeated until the lamp starts.

A lamp that has reached the end of life will keep flashing in attempting to start until it is removed from the circuit. If the starter switch contacts become stuck together, starting current will flow through the electrodes with a resulting lamp end glow until the starter is replaced.

The two-lamp circuit is really two single circuits combined. One lamp is in series with a reactor and the other is in series with a reactor and capacitor. Therefore, the currents in the two-lamps are out of phase and power factor and

Trouble Check Chart for Fluorescent Equipment

Indication of Trouble	Remedy
1. *Lamp won't start, or lamp flashes on and off. Note: A flashing lamp usually indicates end of lamp life.	1. Be sure lamp is properly seated in lamp holders. 2. Replace with tested lamp. 3. Replace starter with a tested one. 4. Be certain of proper line voltage. 5. Check lamp holders, wiring and ballast.
2. Lamp flickers, arc wiggles, spirals or flutters.	1. Turn luminaire on and off several times. 2. Allow a new lamp to operate several hours for seasoning. 3. Remove lamp and shake with one end down. 4. Replace lamp if flicker persists. 5. If flicker is repeated in a new lamp, replace the starter.
3. Ends of lamp glow+, no starting effort.	1. Replace starter. 2. Be sure wiring connections agree with diagram on ballast.
4. *Lamp starts slowly (should start in a few seconds)	1. Be certain of proper line voltage. 2. Replace the starter.

* Note: If these troubles are encountered where room temperature is below 50° F, refer to the previous discussion on fluorescent luminaire "Operation at Low Temperature."

\+ Note: If luminaire is equipped with FS-4NA (No-blink) starters, continuous end glow indicates normal lamp failure.

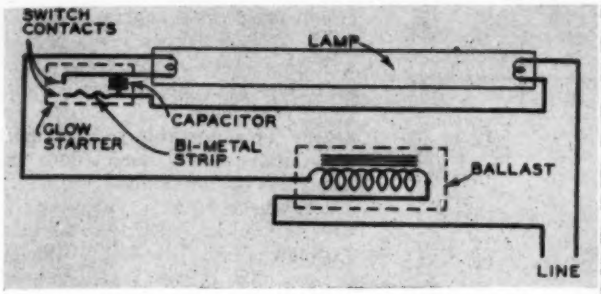


Fig. 4. (Above) Single-lamp fluorescent ballast circuit.

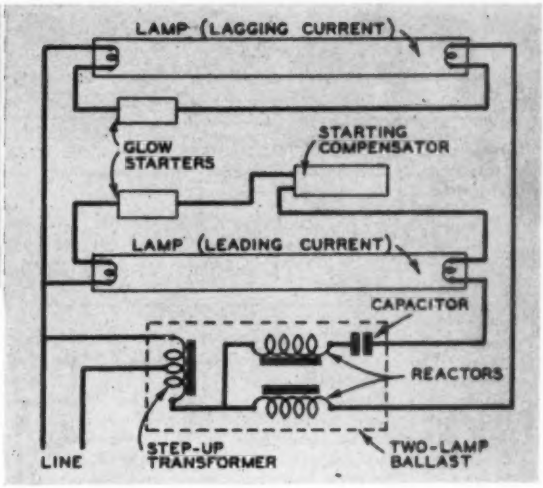


Fig. 5. Two-lamp fluorescent ballast circuit.

cyclic flicker are corrected. Both lamps start with the same procedure as a single lamp circuit. The starting compensator is absolutely essential in the leading circuit for all 15, 20, 30 and 40 watt two-lamp circuits to provide the correct starting current. If compensator is left out of the circuit, lamps will start but short lamp life will result.

In addition to knowing the fundamentals of operation, maintenance electricians should:

1. Understand the importance of proper line voltage.
2. Know how lamps normally fail.
3. Be familiar with lamp, starter and luminaire testing.
4. Realize the necessity for regular luminaire cleaning.

Correct Line Voltage

The first requirement for the satisfactory operation of fluorescent lighting is to have *proper line voltage.* The line voltage must be within rated limits marked on the luminaire or ballast. Standard voltage ranges are 110-125, 199-216, or 220-250 volts, as marked. The design voltage for these ranges are 118, 208 and 236 volts respectively.

With fluorescent lamps, either high or low voltage beyond the standard range are undesirable. Low voltage, as well as high voltage, will reduce the lamp life and the efficiency. Low voltage may also cause a lamp to flash on and off and may prevent satisfactory starting. High voltages may burn out the ballast or lamp electrodes.

Be certain that line voltage at the fixture is correct before attempting to locate any trouble in the luminaire.

Fluorescent equipment is designed for one frequency only as indicated by the luminaire nameplate or ballast label. A 60-cycle unit should never be operated on 50 cycles nor should a 50-cycle unit be operated on 60 cycles. It equipment is to be operated from direct current, special auxiliaries must be provided. Failure to observe these rules will cause ballast failure and short lamp life.

Normal Lamp Failure

When a fluorescent lamp reaches normal end-of-life, it will usually flash on and off if the luminaire is equipped with FS-2, FS-4, FS-44, FS-6, or FS-64 starters. Flashing lamps should be promptly replaced because this flashing overworks the starter by causing it to open and close thousands of times in a few hours. Hence, continued flashing will destroy the starter in 24 hours or less. Also, continued flashing overloads the ballast and may cause ballast failure.

Where luminaires cannot be easily and quickly relamped they should be equipped with "No-Blink" starters. With this type of starter, an inoperative lamp does not flash, therefore, ballast and starter are protected until lamp can be replaced.

The rated life of a fluorescent lamp or any other type of lamp is an average of a great many lamps tested under specified controlled conditions. A few lamps will fail before rated life is reached, while others will burn far beyond the average point.

There are several factors beyond the control of the lamp manufacturer that may adversely affect lamp life. As mentioned above, proper line voltage is essential. Life may be shortened if line voltage is above or below the limits of the ballast rating. Frequent starting also shortens

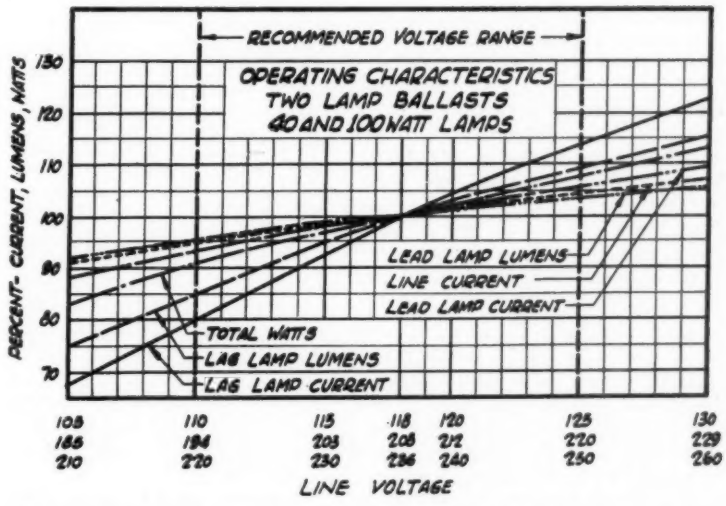


Fig. 6. Operating characteristics of two lamps on a two-lamp ballast.

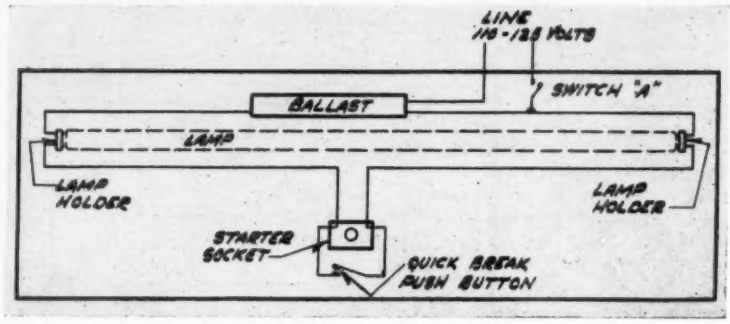


Fig. 7. This easily constructed test board can be used to test both lamps and starters. To test lamps: (1) place lamp in lamp holders and close switch "A"; (2) compress push button for several seconds, then release; an operative lamp should light immediately if all base pins are making firm contact in the lamp holders; (3) rotate lamp 180° and repeat test. To test starters: (1) install a new lamp in lamp holders and check as above to make sure lamp will operate properly; (2) open switch "A"; (3) insert starter in starter socket; (4) close switch "A"; (5) lamp will start and operate continually if starter characteristics are normal; (6) if ends of lamps glow continually but lamp does not start, starter contacts are stuck and it should be discarded; (7) if ends of lamp do not glow at all, starter breakdown voltage is too high and starter should be discarded. Note: line voltage should be approximately 118 volts and test board should never be used on less than 110 volts.

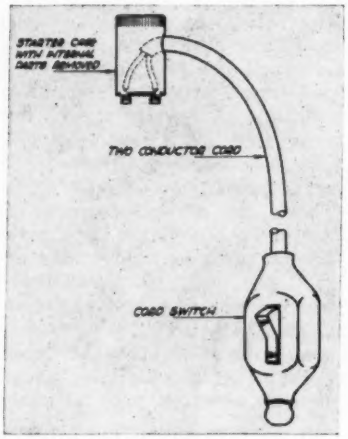


Fig. 8. This easily made manual starter will facilitate lamp and starter testing in the luminaire.

lamp life. Rated life is based upon an operating period of 3 to 4 hours between "starts."

All luminaires using two-lamp ballasts should be equipped with a "starting compensator" in the lead lamp starting circuit. If this small item is left out by the fixture manufacturer, short lamp life will result.

Lamp and Starter Testing

Every lamp and starter should be tested before installation because lamps and starters are fragile and may possibly be damaged in shipment or handling.

This check procedure will reveal any defectives and will prevent wasted time in making new installations or in maintaining equipment in service. Figure 7 illustrates a simple test board that can be constructed with readily available parts.

To check starters and lamps in a luminaire, a manual starter, as illustrated in Figure 8, is recommended. When a lamp does not operate properly, remove the starter and insert the manual starter. When the switch is in the "on" position, ends of lamp should glow. If no glow appears, insert a new tested lamp. If the ends of the new lamp do not glow with switch "on," lamp holders, wiring or ballast may be defective. When lamp ends glow with switch "on," open switch and a good lamp will start. If lamp refuses to start after opening the switch several times, install a new lamp.

When lamp starts properly with the manual starter, but did not start with the old starter, the trouble is probably in the starter and a new one should be installed.

Occasionally a luminaire will not function properly, even with lamps and starters that operate satisfactorily in another fixture. Therefore, it is desirable to quickly check the electrical characteristics of the unit to determine the location of the fault. A simple indicator type of circuit analyzer for this purpose is described on page 35.

A sketch of this analyzer is illustrated in Figure 9. It can be constructed from parts available in most any hardware store or factory maintenance shop. The voltmeter can be a small panel type instrument built into the analyzer, or a portable general purpose instrument connected to the analyzer by detachable leads.

For checking 15 to 40 watt fluorescent units, use two 40-watt, 120-volt inside frosted filament lamps. For 100-watt fluorescent units, use 100-watt, 120-volt filament lamps.

To check a luminaire:

1. Remove all lamps and starters.

2. Insert the starter plug in the starter socket.

3. Insert lamp plugs in lamp holders.

4. With switch "S" open, read open circuit voltage.

5. Close switch "S" and note appearance of lamps. The accompanying trouble-shooting chart explains the appearance of the filament lamps A and B when luminaire operates properly or when some defect is present in the circuit.

By plugging the analyzer into a luminaire that is operating properly, the user can familiarize himself with the appearance of the lamps under normal conditions.

When possible, it is suggested that a defective luminaire be removed from service for testing and repairs. However, the unit should be grounded while testing and care should be taken to connect the grounded side of the line to the white lead from the fixture before testing.

With any reactor or high reactance transformer there is always some "hum" generated by the alternating magnetic force pulling on the sheets of iron in the core. Ballasts are now designed and factory inspected to minimize this hum, but certain economic limitations and necessary physical shape prevents the elimination of "hum" in some types of ballasts.

Hum is usually not objectionable in factory areas, offices, or other locations where a normal noise level exists. However, it should not be expected that fluorescent equipment will be perfectly noiseless in very quiet rooms.

If an occasional ballast is particularly noisy, it should be replaced.

Operation At Low Temperature

If fluorescent luminaires with Mazda F lamps are used where the surrounding temperature is below 50° F, operating trouble may

be encountered unless proper precautions are observed when installation is made. The lamp may flash on and off or may simply refuse to start. The conditions may be remedied by:

1. Providing voltage at fixture well above minimum rated voltage. For example, provide 120-125 volts on a 110-125 volt unit.

2. Having lamps completely enclosed by luminaire to conserve lamp heat. For example, a closed-end industrial reflector should be equipped with a clear glass cover.

3. If remedies 1 and 2 are impractical, 40-watt Mazda F lamps may be replaced by the new low temperature lamps known as 40-watt LT lamps available in 3500° white only. Because of the special design of this lamp, the life and lumen maintenance will be less than the standard lamp. For this reason, it should only be used when absolutely necessary!

4. Starting difficulty at low temperatures may be practically eliminated by using thermal type starters. Two such starters are available, the FS-44 for 40-watt lamps only and the FS-64 for 100-watt lamps only. The FS-44, however, is a 4 contact starter and cannot be used in FS-4 starter sockets. Luminaires must be rewired to accommodate the FS-44. The FS-64, however, is interchangeable with most FS-6 starters in 100-watt luminaires because most units are furnished with four contact starter sockets.

There are a few common causes of trouble with fluorescent equipment that are easily remedied by following a simple check procedure which is given in the accompanying table.

Miscellaneous Maintenance Hints

Some manufacturing processes liberate acid fumes that attack metals such as copper, brass, bronze or steel.

The material affected will depend entirely upon the type of acid and its concentration. The best way to prevent serious corrosion where acid fumes exist is to install enclosed vapor-tight luminaires and to clean these units frequently. The top of a reflector covered with dust will hold the acid, and corrosion may even attack porcelain enamel. If the reflector is frequently washed with a neutralizing cleaner, most acids will have no effect on porcelain enameled units.

When luminaires are relamped, care should be taken to install a lamp of proper wattage and voltage rating. Luminaires should not be overlamped or underlamped because efficiency and quality of lighting will be sacrificed.

Lighting units may be controlled by panelboard, no-fuse breakers, wall switches, canopy switches at the luminaire, or by pull chains on each luminaire socket. The first maintenance rule for the care

(*Continued on page 86*)

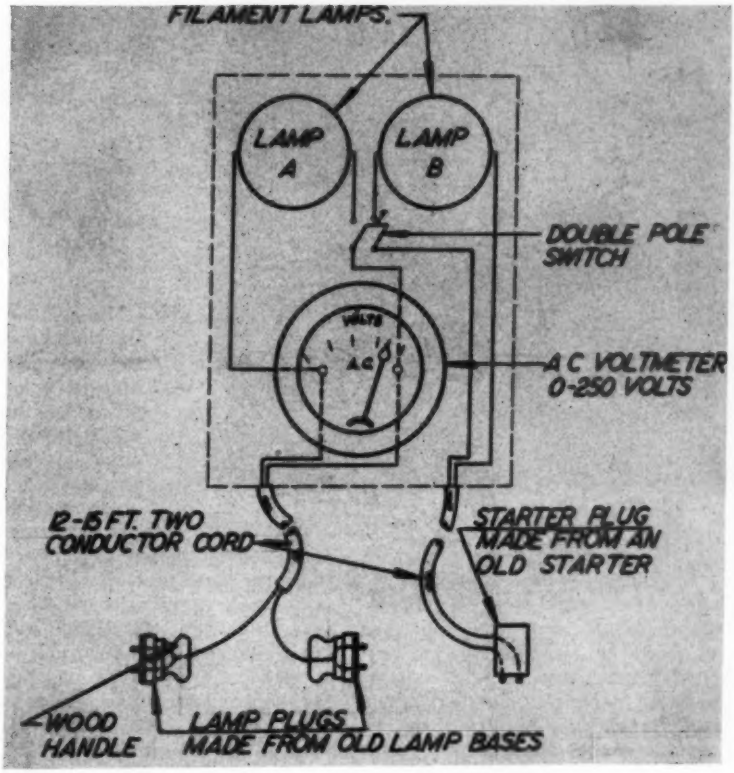


Fig. 9. Schematic diagram of fluorescent analyzer of simple construction. The following instructions describe its use.

Normal Lamp Operation

1. Open-circuit voltage* must be at least
   118 volts for 15 watt lamps
   118 volts for 20 watt lamps
   200 volts for 30 watt lamps
   200 volts for 40 watt lamps
   150 volts for 100 watt lamps
2. Both lamp A and B glow dim with same brightness—normal for lag circuit.
3. Lamp A glows dim and lamp B glows very dim—normal for lead circuit.

***Based on ballast design voltage being applied to luminaire. Open circuit voltage can vary plus or minus 7½% with plus or minus variations in line voltage.**

Indications of Defects

1. Zero open-circuit voltage and neither lamp glows: cause of trouble—lamp holders, wiring or ballast; remedy—check lamp holder contacts and wiring. If no loose connections or grounds are found, replace the ballast.
2. Open-circuit voltage correct; lamp A glows bright; lamp B does not glow: cause of trouble—starting circuit open; remedy—check starter socket and wiring for loose connections. Trouble in starting circuit of lead lamp may be caused by open circuit in compensator. Short circuit the compensator and if lamp B glows, compensator is open and should be replaced.
3. Open-circuit voltage correct; both lamps A and B glow extremely bright: cause of trouble—shorted lag reactor; remedy—replace ballast.
4. Open-circuit voltage O.K. Lamp A glows extremely dim; lamp B does not glow: cause of trouble—shorted lead reactor; remedy—replace ballast.
5. *Open-circuit voltage low—approximately equal to line voltage; both lamps glow very dim, or lamp A is very dim and B does not glow at all: cause of trouble—burned out auto-transformer; remedy—replace ballast.

***This trouble will only be found in 30, 40 and 100 watt luminaires.**

Luminescent

By Samuel G. Hibben*

The application of luminescent materials to blackout and dim-out problems lends particular emphasis to this interesting appraisal of the phosphorescent and luminescent paints and dyes.

AMONG the various protective lighting developments or devices that have been incited by blackouts and dim-outs, none has spurred the imagination nor excited the curiosity as much as luminescent materials. Defined as the storage batteries of light, these are the substances that absorb radiation (visible or otherwise) and that without further ado will give it out again, repeatedly.

If the "giving" occurs only during the time of irradiation, it is fluorescence; if the emission of light persists quite long afterward, it is phosphorescence.

Research scientists and numerous instrument manufacturers as well as the military authorities have been familiar with the possibilities and the shortcomings of the phosphorescent devices in particular, but the average contractor, painter, merchant or architect is still unaware of the practical uses. It, therefore, seems timely to appraise the properties and applications of both fluorescent and phosphorescent materials. These are no longer toys, and in the case of phosphorescent applications, especially, we may be dealing with a sleeping giant.

Fluorescent Usage

Since fluorescent response is practically instantaneous, beginning and ceasing with the exciting radiation, it is generally limited to those applications where the emitted fluorescent light is not washed out or diluted by the exciting light. In short the first necessity is to generate black light or more broadly the utraviolet (invisible) radiations between some 2000 and 4000 Angstroms and to rely on the inherent property of the fluorescent substance for the final visible brightness and color.

The actual brightness of the fluorescent material, depending as it does chiefly on the intensity of the exciting radiation, might theoretically reach very high values. In the phosphor coating of the green commercial Mazda F lamp, for instance, it reaches more than 8.5 candles per square inch (or nearly 4000 footlamberts). There are practical limitations but in practise the variety of color responses from fluorescent objects is very wide indeed, and the intrinsic brightness has an indefinite maximum that can be very much greater than the brightness of any known phosphorescent material.

First, then, as we appraise fluorescent possibilities, we might note that wherever we can generate black light liberally, we can get higher brightness or higher visibility with fluorescent objects than we can with phosporescent ones. For example, the shop window exhibit on a reasonably dark street, as in a dim-out zone, could well be arranged with one to a half dozen 100-watt high intensity mercury projector lamps, Type C-H4 or E-H4, these equipped with dense purple glass filters and in themselves producing no visible light except a trace of deep blue and violet. Articles on display, in addition to the fluorerscent signs easily stenciled or lettered on cardboard, would include many items that will probably surprise the merchant as well as the shopper.

A survey of the stock of the average gift or novelty shop might disclose much fluorescent glassware, needle-point embroidery, many silks and other fabrics, petroleum com-

*Mr. Hibben is director of applied lighting for Westinghouse Lamp Division. He is chairman of the Committee on Illumination Materials, Illuminating Engineering Society, and member of Luminescent Coatings Committee of Federation of Paint and Varnish Clubs.

Materials

The photographs reproduced on these pages indicate some of the practical applications of luminescent materials. (Upper left) Important blackout bulletins can be made as visible as a softly glowing neon sign although no discernable light is nearby. (Upper right) Phosphorescent markings are aids to night time safety during blackouts. (Lower left) Invisible ultraviolet radiation and fluorescent dusting powder disclose checks that have been altered. (Lower right) Shirt tail markings with invisible ink show up brightly under ultraviolet "black light."

pounds and medicines, oilcloth, a plurality of plastics, even some woods and leathers and a host of oriental enamels and antiques.

Supplementing the natural responses of many objects would be the temporarily applied fluorescent paints or dyes which may be temporarily brushed or sprayed on almost any solid materials without marking or destroying them. Fluorescent dyes may be cleverly applied to indicate some peculiar characteristics,—a sort of "X marks the spot" effect.

Fluorescent dyes generally of the organic types have been limited to indoor usage. Exposed to weathering and particularly sunlight and dampness, the average fluorescent material will fade or become less responsive to the exciting radiation.

Protective lacquers and overlays of cellophane or glass may be used because most commercial fluorescent materials respond to the exciting radiation in the band roughly centering at 3600 A. and this kind of black light will pass through glass and many transparent plastics very easily.

The chief deterrent in applications of fluorescent displays or marking devices lies in the fact that there must always be a team of items—the target and the black light source. So little effective black light is produced by tungsten filament lamps that these are only satisfactory for very close ranges and brief periods. Commercially and practically, the black light for window displays, murals, or wall paintings, and what might be termed broadcast applications, can quite well be provided by replacing the ordinary Mazda fluorescent lamps with corresponding sizes and wattages of the fluorescent lamp designated "360 BL."

The phosphor coating of these particular black light sources generates a mixture of visible and ultraviolet radiation so that it is still necessary to screen out the unwanted visible by (1) using pot blue sheet glass as a filter over the mouth of a reflector trough, or (2) wrapping individual 360 BL lamps with spiral deeply colored cellophane tape or apply a light-absorbing purple dye or transparent lacquer to the tubular lamp bulb.

For spotlighting or projecting, as when illuminating a picture, a special window trim, or the aisle carpet in a theater, it is preferable to employ the 100 or the 250 watt high intensity mercury lamps, these should always be equipped with dense purple filters and, in addition, occasionally with prismatic control lenses or louvers. For longer range black light projection, such as the theater stage or the military searchlight, the special type of low intensity high voltage carbon arc is useful.

Phosphorescent Usage

Phosphorescent materials as contrasted to fluorescent ones are becoming of increasing interest because they are independent of the exciting radiation to a great degree. The common basic phosphorescent inorganic pigments such as zinc, calcium or strontium sulphides are excited readily by daylight and by almost every variety of artificial light.

Moreover, these phosphorescent substances have a wide range of sensitivity and are not too critical of the quality of incident illumination. Under some normal illumination as from commercial fluorescent lamps, the excitation will be greater or at least quicker (by perhaps 5 times) than when using

(Continued on page 82)

Living Behind the Blackout

By C. B. Osborne*

PUBLIC thinking concerning blackouts is very confused at present. This is particularly true in our inland cities where military pressure on Civilian Defense organizations to make adequate blackout and air raid preparations is negligible. Air raids and the necessity for blackout seem a very distant threat to the majority of our people. Heaven grant that the threat may never become an actuality but alert thinking dictates that complacency in this respect should be abandoned.

The response to blackout requirements in most cities where practice blackouts have been held has been made by putting out all the lights when the public air raid warning alarm sounded and quietly watching out the window or from some high vantage point to see the "show." Following these practice blackouts, proud statements are usually made by officials concerning the percentage of effectiveness of the blackout. It must be realized that a blackout must be 100% or it is totally ineffective. Ninety-nine point forty-four per cent will suffice for soap but not for blackouts!

The success of a blackout plan depends upon the knowledge and cooperation of all the people concerned and advance planning and preparation will contribute most to its success.

Blackout does not mean that we must sit in the dark, inactive, waiting. That is what our enemies would have us do. Lighting in wartime plays a tremendous psychological role. English experience shows that it was not only necessary to teach how to blackout but also to teach how to have adequate lighting at the same time.

War or no war, life must go on in the American home. In nearly every home in the land wives and husbands will be found studying and reading as never before—first aid, air raid warden service, sewing, knitting. Adequate light is needed for normal living behind the blackout.

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*Mr. Osborne was formerly sales manager for the Electric Power Board of Chattanooga, Tennessee. On September 1, he reported for duty as a lieutenant with the United States Navy.

Photos courtesy of Westinghouse

Sonny has to wash up before he goes to bed, even if there is a blackout. The opaque black material was used as a flat shade for this window and decalomanias applied for ornaments.

That's not a cabinet with curtains pictured at right but a blacked out kitchen window. The decorated panel is made of lightweight ivory building board in two sections with handles for ease of installing. A narrow molding against which the board fits makes it light tight. Designs cut from a remnant of the wall paper are glued to the board for decoration. Cost is low since this kind of board is available at 6c per sq. ft.

It is the electrical industry's responsibility to educate the public along proper lines. This can best be done by cooperating with the Office of Civilian Defense, and members of the industry should identify themselves with blackout committees and air raid warden service in order to encourage proper thinking concerning blackout and adequate lighting behind the blackout.

In the home, the first step is to choose at least one room for use as a shelter room. This room should be comfortable for all those who must gather there during the blackout and it should be a room easily blacked out. This shelter room need not necessarily be the place of refuge during an actual air raid. English people take refuge under a table or bed during an air raid but continue life as normally as possibly during blackouts.

The second step is to carefully plan what means shall be used to blackout the shelter room. A search of the average home will usually reveal bed-spreads, blankets, old portieres and other materials that may prove satisfactory for the purpose. Such materials should be tested by hanging them temporarily over a window at night, turning on all the lights in the room and checking on the outside to make sure that no light penetrates.

If no materials are available in the home, there are many suitable materials available in the stores at various prices. Heavy opaque roller shades provide the simplest and quickest means for blacking out but precautions must be taken to make them wide and long enough to overlap the window glass sufficiently to prevent light leakage. A very definite psychological advantage is gained by using cheerful and colorful materials. Coated black cloth, colored sateen, brocades, velours and many attractive materials are available to fit one's budget.

Ventilation of the shelter room should be given consideration. If furnace or other fans are not installed in the home, an ordinary electric fan can be used to circu-

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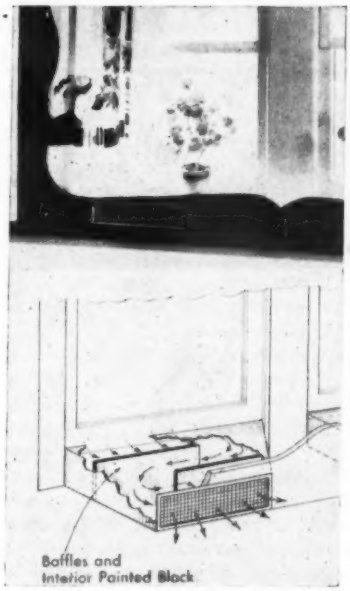
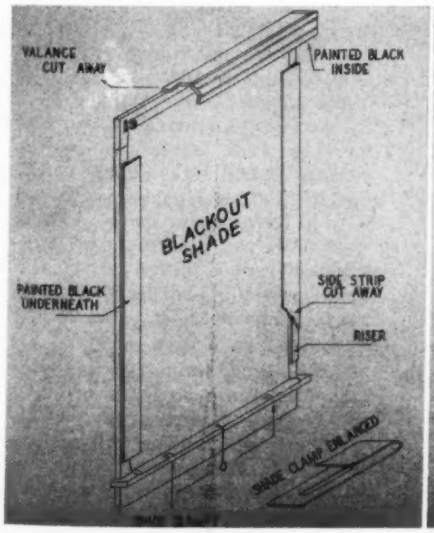
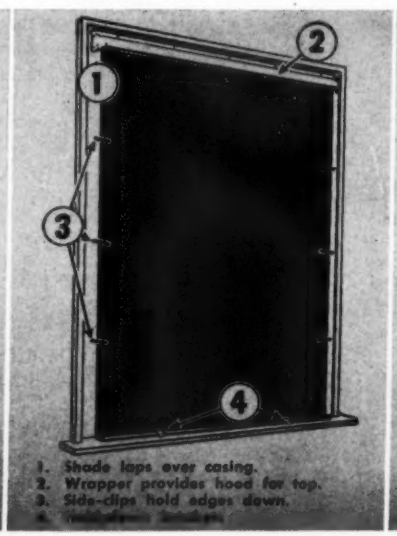
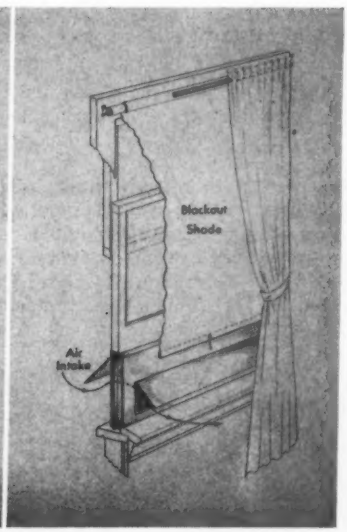


The photos and diagrams show various methods of blacking out windows in homes. Of particular interest are the methods of providing ventilation.







There Won't Always Be a War!

By Roy A. Palmer

We face a long hard struggle, one that will require our every effort and sacrifice. But men in the lighting industry will be bouyed by the thought that there won't always be a war; and that in the peace that follows, we can apply to the fullest extent the developments and improvements that have come out of the war.

LIGHT IS DOING its part in helping to win the war. Night and day, hour after hour, it is silently, constantly and effectively working to create the materials of war. Without light, twenty-four hour operation would not be possible. In the great majority of plants, even daytime operation would be very seriously handicapped without light.

With the big job that light and lighting has to do, new and bigger problems arise that must be solved quickly; new applications of light arise from time to time; past practices and precedents must often be discarded in order to meet the urgent needs of the job at hand; the skill and experience of individuals engaged in all types of lighting work are placed under unusual pressure. The result is that lighting is undergoing a tremendous development which is to be of inestimable value to the industry and every user of light after the war.

The advent of war, of course, has greatly dislocated the lighting industry like all other industries. A large number of lighting engineers have gone into military service. Many manufacturers have converted their production to war products not related to lighting. Electrical contractors and lighting equipment dealers, pressed by inability to obtain material for installation in other than war industries have, in many cases, either closed up or are handling other merchandise. Such radical disruption might ordinarily bring lighting progress to a standstill, but under today's circumstances this is not the case. It is heartening, therefore, to those who look forward to re-entering the lighting business when victory is won and peace comes again, that enormous progress will have been made during these strenuous days, and the need for their experience and services will be greater than ever before.

For many years lighting engineers and salesmen have known of the value of good lighting as a production tool in industry. More than twenty years ago tests were conducted with meticulous care in several industries to determine just how much lighting affected production. The results of those tests proved to the lighting engineers that their contention of increased production under improved illumination was correct.

But tests couldn't be conducted in every factory. The plant executive had to be sold on the idea by the sales ability and the sincerity of the lighting salesman. He had to be convinced that the cost of improved lighting would pay for itself in the advantages gained.

The experience of plant after plant eased the sales resistance so that hundreds of mills and factories have enjoyed the benefits of better lighting. But still the level of illumination throughout industry is far below the standard which really produces worthwhile benefits. The conversion of existing industrial plants and the construction of new ones is raising the average because the lighting in them is generally of a high standard.

Lighting's Value Recognized

Today, those responsible for war work in industrial plants recognize the value of better lighting. The War Production Board has issued a booklet, "Plant Efficiency," in which good lighting advantages are outlined. In addition to increased production, this booklet points out that other advantages are obtained such as better workmanship, continued production by older employees, less eyestrain, reduction in accidents, better morale, and better housekeeping. It also points out the qualifications of a good lighting system and how competent engineers can be secured from utilities or manufacturers to provide good layouts.

The number of high-class lighting jobs that have already been installed serve as a vast laboratory where workers and plant executives will prove for themselves the value of good lighting. With speed paramount in every war plant today, the seeing of every worker must be unhampered. Accidents due to inadequate lighting causes loss of valuable man-hours and spoilage of critical materials. Good seeing contributes toward getting things done with less expenditure of nervous energy. Greater accomplishment with less fatigue, therefore, is possible which in turn builds employee morale.

In some war plants, the light equipment numbers many thousands of units. Continuous rows of fluorescent lighting units can be measured by the mile. The levels of illumination range from 40 to 50 footcandles and up. Can any industrial executive fail to give lighting proper consideration after witnessing the experience of such well lighted plants?

Just as lighting is contributing much to the war effort, so, too, is the war contributing a great deal to lighting progress! But if nothing more were gained than the fact that plant executives and workers were being sold on the value of good lighting as a production tool, a long step forward would have been made. Many workers in war plants, today working under good illumination, will be industrial executives tomorrow. Experience is a convincing teacher.

The lighting industry was a consumer of large amounts of critical material. Important as is lighting, the need for these materials is greater for war equipment. The resourcefulness of manufacturers has resulted in the

clever use of substitute materials which, in many cases, serve practically as well as the critical items. Such an experience, while exasperating to those attempting quickly to provide lighting equipment for war industries, nevertheless, is constructive. In the search for substitutes, new ideas, new ways and means of doing things as well as new materials, are being found. It reveals that our thinking about lighting methods and equipment, perhaps, has been following rather narrow channels.

Back in the days of the gas lamp and its predecessor, the kerosene hanging lamp suspended over the dining room table, it was, of course, necessary to keep the equipment within easy reach for lighting and extinguishing it. When electric lamps superceded those lamps, the bulb was suspended on a drop cord from the ceiling. Like the old lamps, the electric lamp had to be within reach to turn it on and off by the key switch on the socket. Then came the separate switch which permitted the lamp to be controlled from a distance. But it wasn't until recent years that we managed to break away from the idea of suspended fixtures.

In the electric lamp we have a light source that can be located far out of reach; it can be confined in a relatively small space without the danger from fire that would be encountered in the case of gas or oil lamps. Thus we have freedom of design which we have not utilized to the greatest extent. Built-in lighting in homes, stores and offices as well as other places can add immeasurably to the attractiveness and utilitarian value of lighting. If the science of seeing and lighting design was mastered by interior decorators, what a marvelous new tool it would prove to be to that profession.

At any rate, our lighting for war has a broadening influence on the minds of those in the lighting industry.

In the same category, the need for conserving and eliminating waste is strengthening the campaign for proper maintenance of lighting systems which a few conscientious lighting engineers have faithfully advocated year after year with somewhat indifferent results. Certainly, it is wasteful to permit dust and dirt, wrong type and voltage of lamp, and infrequent painting (too often with light-absorbing colors) to rob an area of illumination which could be had without the consumption of additional electric current.

We shine our shoes when wear dulls their gloss, and we wash the automobile when dust and dirt mar its appearance, but a lighting fixture is too often undisturbed even though the accumulation of dust, grease, and fingermarks detracts both from its appearance and effectiveness. With the emphasis placed on proper maintenance to avoid waste, we are learning the need for better design of equipment that contributes to the ease of cleaning and relamping.

The new 3,000-watt mercury lamp is evidence that the development of new light sources is not at a standstill. Here is another tool that will help to provide high illumination levels in plants having high bays. Foundries, large machine shops, assembly plants, and similar locations where high mountings are necessary because of the structural conditions, cranes, or nature of the work, are ideal locations for the application of this modern lamp.

Many special lamps have been developed for the army and navy. While they are designed for a particular service, they undoubtedly will find many adaptations to practical peace-time purposes after they have helped to win the war.

(Continued on page 80)

Roy A. Palmer, merchandising and advertising manager for the Duke Power Company, Charlotte, was recently appointed to the staff of the Fourth Region Office of Civilian Defense and will serve as a consultant on "dimout" problems along the Atlantic coast. Mr. Palmer will serve jointly under the Office of Civilian Defense and the Eastern Defense Command headquarters at Jacksonville, Fla. He will make his headquarters in Charlotte and will continue to serve the Duke Power Company as advertising and merchandising manager.

Mr. Palmer's broad experience in the lighting industry will enable him to serve the Fourth Region Office of Civilian Defense advantageously in its blackout and dimout program. He graduated from the University of Minnesota in 1921 with a S. S. degree in electrical engineering. He entered the employ of the National Lamp Works, at Nela Park, Cleveland, Ohio, immediately after graduation. In 1926, he went to Hollywood, Calif., to assist in introducing the Mazda lamp for filming motion pictures. After completing this work, he returned to Nela Park in April, 1928.

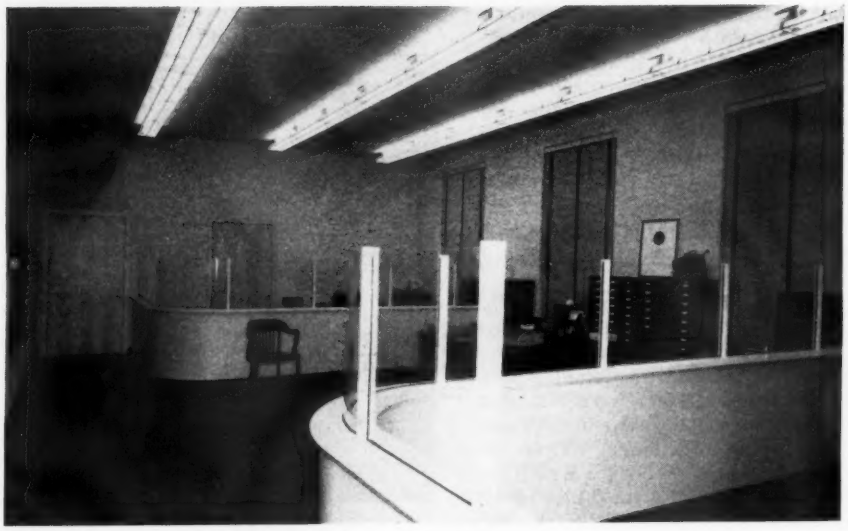
Mr. Palmer left Nela Park in September, 1928, to accept the position of illuminating engineer for Southern Public Utilities (now Duke Power Company) in Charlotte, N. C., a position he held until his appointment as merchandising and advertising manager of the company in October, 1940.

Included in his lighting activities was his appointment as United States delegate to the International Commission on Illumination in Great Britain, in 1931, and his appointment by President Hoover on the Committee on Fundamental Equipment for Home Building and Ownership Conference, Washington, 1931.

He is a member of the Illuminating Engineering Society which he served as director in 1932-1935, local representative for North Carolina in 1928-1940, and as regional vice-president in 1940-41. He served as vice-chairman for the Southeastern Region of the Better Light—Better Sight Bureau in 1941-42. Author of many articles, and a lecturer before many local, state and national organizations, Mr. Palmer is also a member of the British Illuminating Engineering Society, American Optical Society, Charlotte Engineers Club, Charlotte Rotary Club.

As Mr. Palmer says in his article in the preceding pages "There won't always be a war," and some day the lighting industry again will turn its attention to the lighting of stores, public buildings and institutions. Affirming his statement that all our efforts must be directed toward one end—the winning of the war—we present here, only as a matter of interest, a few outstanding commercial lighting installations just completed. These were finished before the priority regulations of the War Production Board wrote "finis" to unessential electrical modernization work.

Wakefield fluorescent luminaires were used advantageously in the lighting of Radio Station WRBC, operated by the Birmingham Broadcasting Co., of Birmingham, Ala. Views of the radio station are shown above and at the right. The area shown in upper photo is 21 feet by 32 feet and is lighted to an intensity of 30 footcandles. The ceiling is 12 feet high. The area shown at the right is 21 feet by 37 feet, with a 12-foot ceiling height. It is illuminated to an intensity of 65 footcandles. The luminaires are spaced 8 feet apart. 3500° white Mazda lamps were used throughout the installation.



A number of lighting innovations were installed by Hall Electrical Co., of Jacksonville, Fla., for the new Mangel's Feminine Apparel store in that city. Two views are shown at the left. The first floor is efficiently lighted with a combination of fluorescent and incandescent units. The lingerie section has the general fluorescent lighting supplemented by a line of pendant type spots. Dresses, suits, coats, etc., are displayed in stationary recessed wall racks. Lines of fluorescent lamps extend the length of the racks. This feature has been particularly approved by salespeople and customers since it permits inspection before removal from rack.

From both architectural and lighting viewpoint, the remodeling of the Baker Hotel, in Dallas, Texas, is one of the outstanding jobs in the Southwest. The photos reproduced on this page show the Texas Room (right), the lobby (center), and the mezzanine (bottom). Lighting in the Texas Room is provided by flush-type ceiling fixtures, each containing thirty 40-watt incandescent bulbs. Interspersed with the flush units are spill rings using 300-watt lamps with reflectors in back. Average intensity is 30 footcandles but this can be increased to 40 footcandles under the spill rings. Ceiling height in this room is 18 feet.

The main lobby originally had a ceiling height of 28 feet. In remodeling, the architects reduced this to 12 feet and provided space for an entirely new mezzanine meeting room. Features of the lobby include light woodwork, murals and an attractive but efficient lighting system. In the ceilng are 39 recessed coffers containing special bronze fixtures with reflector bowls at bottom using 200-watt incandescent lamps. Rows of natural white fluorescent lamps in troughs along the sidewalls light the murals. Louvred down-lights provide suitable illumination at the room-clerk's desk and in the executive offices.

Utility and beauty are combined in the design of the stairway leading to the new mezzanine floor. A double stairway in the lobby, it converges to a single stairway halfway up to the mezzanine floor. The balustrades are of heavy etched glass and bronze. The etched designs are illuminated by strips of neon tubing concealed in the base. Above the stairway is a large circular coffer. It lights the stairway as well as a considerable portion of the mezzanine. A circular strip of daylight gaseous tubing is mounted around the edge of the coffer. (These photos reproduced through the courtesy of Dallas Power and Light Company.

Strategic War Materials Saved By Manufacturers' Research

By D. P. Caverly*

THE ACTUAL shortage of certain metals, with consequent limitation orders by the War Production Board, have made it necessary in many instances, to change the design of light source and equipment, but a great many changes also have been made voluntarily by certain lamp and fixture manufacturers wholly in a spirit of co-operation with the Victory effort.

Many of these changes or substitutions could have been made quite readily if the manufacturers had been willing to lower their quality standards. But this has not been the case. Regardless of how severe the substitution, the fact that there has been no essential sacrifice of quality is the direct result of many long and wearisome hours spent in laboratories and engineering departments working out "another way."

Incandescent Lamp Changes

Incandescent lamps, for example, have not changed in appearance. Their lumen and life ratings remain the same thus far, and they are just as rugged and sturdy as ever. Yet, many changes have been accomplished to save precious metals for guns, planes, tanks or ships.

The wires leading from the base to the filament are called the lead wires and are made up in three sections, namely, the "inner lead" which extends from the stem press to the filament, the Dumet** which passes through the glass stem press, and the "outer lead" which is within the screw base (Fig. 1). In general the inner leads have been pure nickel wire and the outer leads pure copper wire (with the exception of small vacuum lamps in which all copper leads are used, and also with the exception of the fuse wires in gas-filled lamps.)

Now, however, nickel plated iron leads have been substituted, thus effecting a saving of two of today's most essential war metals. This saving alone is expected to amount to 20 tons of copper and 15 tons of nickel each month.

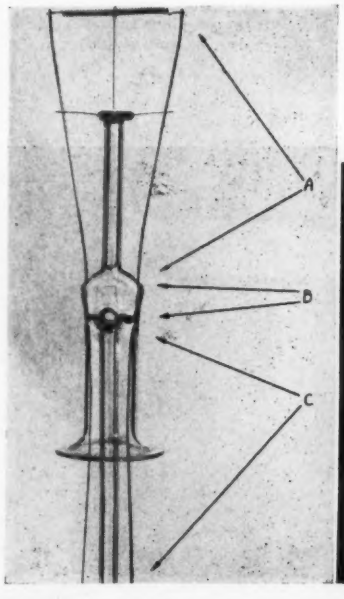
Screw bases, which have always been made of solid brass, are now brass-plated steel. The brass plating is necessary to keep the steel from rusting and corroding in service, but the use of steel in this instance is estimated to release for armament use approximately 500 tons of brass each month.

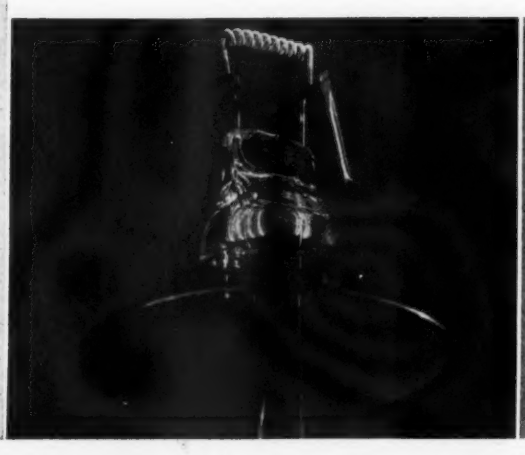
Since the largest portion of tin ore reaching this country came from South Pacific regions, it has been necessary for WPB to restrict the use of tin largely to war materials. The solder used to secure the lead wires to the base has in the past been a tin-lead composition. The substitute solder is silver-lead, or in some cases a silver-bismuth-lead composition. Although the amount of tin released by this change, of course, is very small in each lamp, it should be remembered that the lamp industry produced one billion three hundred and fifty million incandescent lamps last year.

The shellac used in the cement which secures the base to the bulb is obtained largely from East In-

*Mr. Caverly is associated with Sylvania Electric Products, Incorporated, Salem, Mass.

**Dumet is a special type of wire having the same expansion characteristics as the glass through which it passes, so that glass cracks and leaks will not develop. It is a wire having a nickel-iron core and a copper sheath. Only very short lengths are used in incandescent lamps.





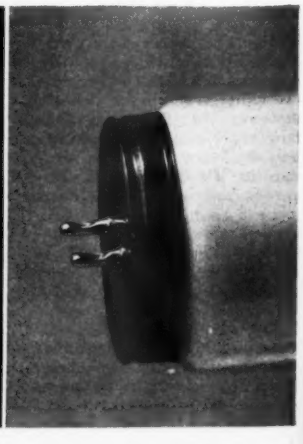


Fig. 1. (Left) The coiled-coil filament, 100-watt lamp mount showing the inner leads (A), the Dumet (B), and the outer leads (C). Fig. 2. (Middle) A 40-watt fluorescent lamp mount showing the "mercury bomb" extending down from the righthand support. Fig. 3. (Right) The new lamp base showing the "crimped pin" construction.

BOY! This saves rubber

NATIONAL ELECTRIC
"DILEC" "FIRE-STOP"

"Rub'Less"

ELECTRICAL CONDUCTORS

NO SYNTHETIC—NO RUBBER

NO TINNING

Same dimensions and appearance as regular rubber covered wire

FLAME RESISTANT
MOISTURE RESISTANT
SMOOTH—SLICK—CLEAN

SOLD ONLY WITH UNDERWRITER'S LABEL

Governed by Copper Priority Rules

NATIONAL ELECTRIC PRODUCTS — WIRING SYSTEMS — WIRES AND CABLES

National Electric Products Corporation
Pittsburgh, Pa.

Fig. 4. Part of a large bomber plant in the Midwest. In installations such as this one, the saving in steel through the use of non-metallic reflectors might exceed 400 tons. This installation, however, utilizes steel reflectors, since non-metallic reflectors had not been perfected at the time the installation was made.

dian sources and is fast becoming extremely scarce. At present time lamp company laboratories are working on a satisfactory substitute.

In the larger types of incandescent lamps, a mica disc is used to prevent heat damage to the stem press and base when the lamp is burned in a base-up position. Heretofore, a clear quality mica, free from major flaws and flecks, was used to improve the lamp appearance. Now, however, since clear mica is needed for more important war devices, the lamp manufacturers will use a heavy stained mica. Not as good looking, perhaps, but an important substitute.

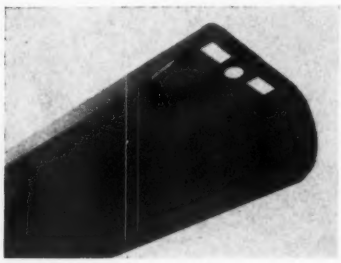


Fig. 5. A "raw" non-metallic fluorescent reflector, ready for the baked enamel processing.

Changes are being made in manufacturing processes as well as in the products themselves. Lamp manufacturing machines, for instance, handle air, nitrogen, argon and illuminating gas. These are piped or carried to the various machine positions through heavy rubber tubes, but replacements of this tubing must be made with a substitute. It is expected to be a non-essential plastic material.

Savings Back of the Switch

As far as fluorescent lighting is concerned, large savings in metal have been effected not only in lamps and fixtures, but through the use of fluorescent lighting itself.

It is obvious that more metal is required in the manufacture of a fluorescent unit than an incandescent unit producing the same amount of light. But when consideration is given to wire, transformer, and generating capacities —as well as to the conduit sizes required behind each type of unit —the copper and steel used is found to be considerably less with fluorescent lighting.

In order to obtain a clear concept of this situation, it might be well to make an analysis of a typical 50-footcandle installation, using 1 kilowatt of fluorescent lighting as a basic unit. (This would cover an area of about 400 square feet.) To obtain the same illumination over the same area, about 2.5 kilowatts of incandescent lighting would be required. Fluorescent fixtures necessary to do this job would contain approximately 236 lbs. of steel and 9 lbs. of copper (in ballasts), whereas the incandescent reflectors would contain only 33 lbs. of steel.

Material on file in the office of the Power Section of WPB and other data obtained from utility

(*Continued on page 78*)

Comparison of Quantities of Steel and Copper Required for Lighting Fixtures

Type of Installation		Weight of Materials for 50 Footcandles		
		Generating and Distribution	Fixtures	Totals
Incandescent (2.5 kw)	Copper	300 lbs.	--- lbs.	300 lbs.
	Steel	1077 lbs.	33 lbs.	1110 lbs.
Fluorescent (1.0 kw)	Copper	120 lbs.	9 lbs.	129 lbs.
	Steel	431 lbs.	236 lbs.	667 lbs.

WANT PRODUCTION INCREASED IN A HURRY?

"Well, since Curtis Industrial Lighting Equipment has been installed we have been getting 'day shift' production 24 hours a day.

No. 1507-C

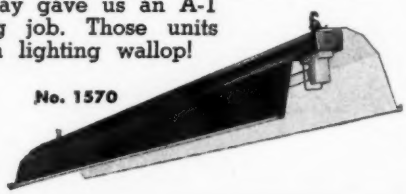
WHERE WE USED INCANDESCENT

No. 589-T

"In many places we used incandescent lighting. Here, Curtis No. 589-T with 1500 watt lamp was the answer. They are easy to install and maintain, and their Silver Mirrored Glass Reflector provides a first-class, high-intensity directional lighting job. The No. 589-T unit has a special tripod holder with a cast metal ring at the bottom, which protects the reflector.

IN THE REALLY HIGH BAYS OF ANOTHER DEPARTMENT WE USED CURTIS NO. 1570

"This is made for the new 3KW Mercury Mazda AH-9 lamp. We found that one unit to a bay gave us an A-1 lighting job. Those units pack a lighting wallop!



No. 1570

IN THE ASSEMBLY ROOM WE USED THE LATEST NON-METALLIC "FLURATEX" REFLECTORS

"Curtis is right in there helping to conserve metal and has switched from steel to their new chip-proof Non-Metallic reflectors. We find them rigid and they are guaranteed to give first-class performance.

"There are three different types: No. 1506 for two 40 watt fluorescent lamps, No. 1507 for three 40 watt lamps and No. 1508 for two 100 watt lamps.

"Those 'Fluratex' reflectors are finished in Fluracite. This is a baked, synthetic reflecting surface which is glossy white and very tough. Curtis discovered and developed Fluracite, especially for use with fluorescent lamps. We've found that it possesses unusually high reflectivity and is easily cleaned with soap and water, or with any of the common (non-abrasive) cleaning compounds. Curtis has used Fluracite on their fluorescent products for over 3½ years.

"I'm sure the Curtis representative would be happy to help you with your lighting job or if you like, you could write direct to the factory."

CURTIS LIGHTING, INC.

6135 W. 65TH STREET... CHICAGO

Scientific Appliance Service Built Up Sizeable Volume

A SCIENTIFIC approach to electrical appliance service, utilizing special testing equipment which takes the guesswork out of repairs, is featured by James C. Madden and John L. Meyer, Jr., of Miami, Florida, who have established a thriving appliance service business. More than 5,000 repair jobs were serviced in their first year of business, just completed a few weeks ago.

With more than a dozen years of utility-company training tucked into their mental tool kits when they started their enterprise, Messrs. Madden and Meyer realized that before them lay a broader market than the servicing of household appliances. For some time they had observed that hotels, restaurants and beauty shops were outfitting with bigger and better electrically-operated devices. Doctors were doing the same thing.

So, Madden and Meyer who conduct their business under the trade style of "Florida Appliance Service," proceeded to equip themselves to handle commercial and professional apparatus, as well as domestic items.

For instance, they rigged up a device for testing the temperature controls of commercial pressing-irons. It is just as useful, of course, in checking the household type. The essential part of the equipment is a thermo-couple. This instrument they mounted on an asbestos-covered wooden base large enough to test the biggest hand-operated pressing irons. The terminals from the thermo-couple are attached with silver solder to a 2" x 2" aluminum plate set in flush with the top surface of the asbestos.

When the iron to be tested is connected up, the device registers the amount of heat developed at each of the temperature-positions. For example, the correct temperature for pressing rayon is 200° to 225° F. If the testing instrument reads over or under at that position, the proper adjustment may be made.

"A tailor," relates Madden, "brought in a pressing iron which had been dropped and its handle broken. We made the repair, and tested the temperature controls. They were out, so we adjusted them. The face of the iron was gummy, and we polished it up.

"This tailor, who operates a large alteration shop, catering to department and clothing stores, was more than glad to pay the small charge for the extra service. In fact, he was so pleased to get his iron back in better condition

Above, James Madden, of Florida Appliance Service, employs a testing device to check pressing iron temperature controls. Right, a 900° thermometer takes the guess work out of an electrical fry kettle adjustment.

"Sure . . . but let me tell you about *my* operation!"

"Brother, it's a honey! We're supplying special parts to an airplane plant. Keeps us hopping 24 hours a day. And production's as good on the night shift as on the day shift. How come? Well, a good part of it's the fluorescent lighting—and the FLEUR-O-LIER fixtures that go with it. They do a job the way our product does in a bomber.

"Yep — FLEUR-O-LIERS, I said. Swell idea. 40 different manufacturers design their own fixtures, but *build* 'em to the same 50 specifications set up by MAZDA lamp experts. Then Electrical Testing Laboratories in New York checks 'em against those standards and certifies the fixtures if they're okay. Yes sir—that FLEUR-O-LIER label on a fixture tells me it's RIGHT!

"And get this. We hung 'em so that we got not only a swell lighting job, but so that we could clean 'em easily. We found if we didn't use soap and water regularly, dirt and dust would cut down light as much as 50%! But outside of cleaning and occasional relamping, we don't have to fuss with FLEUR-O-LIERS. They do a great job!"

FLEUR-O-LIERS

CERTIFIED FIXTURES FOR FLUORESCENT LIGHTING

Participation in the FLEUR-O-LIER MANUFACTURERS' program is open to any manufacturer who complies with FLEUR-O-LIER requirements

***Dependability counts!* See why you get it in FLEUR-O-LIERS**

- **Certified ballasts and starters** . . assuring balanced, economical operation —most light from your lamps—high power factor (over 85%).
- **Durability and safety**
- **Ease of maintenance**
- **Maximum light output**
- **Flicker correction** (on two-lamp circuits).
- **Correct ventilation**
- **Every unit** carries the FLEUR-O-LIER Manufacturers' Guarantee.

★ ★ ★

A vital tool in wartime production, fluorescent fixtures now require a suitable WPB priority rating. Any of the FLEUR-O-LIER Manufacturers, your electrical contractor, wholesaler or electric service company will be glad to work with you on this to get the best lighting possible.

Fleur-O-Lier Manufacturers • 2151-B Keith Bldg., Cleveland, O.

Please send me FREE new booklet "50 Standards for Satisfaction," together with list of Fleur-O-Lier manufacturers.

Name _____

Address _____

City _____ State _____

than it was before being dropped, that he not only has been sending us all of his appliance-repair business but he has recommended us to his friends and business acquaintances."

Madden and Meyer use special testing apparatus for servicing baker's and restaurant equipment —electric ovens and fry kettles. For the latter they use a 14-inch 900° F. thermometer, and for the former a thermo-couple. "The thermo-couple test," explains Meyer, who does much of the firm's commercial work, "is the only accurate method I know of for checking oven temperatures. As soon as one opens an oven door to insert a thermometer, the temperature drops. Since the thermo-couple test is made with the door closed, there can be no doubt as to the interior temperature."

Both firm members stress the advantages of employing testing devices in appliance servicing. Not only do they save much valuable time in locating trouble, but these instruments also reduce to an absolute minimum any complaints that work was not properly done. Moreover, this special equipment has a very definite *merchandising value.* It makes a decidedly favorable impression on the company's customers who feel that the cure of their appliance ailments has been affected with scientific accuracy.

Madden and Meyer have built up sizeable volume in the servicing of the various types of electric fans, ventilating and cooling, commercial and domestic, fixed and portable. Repairs on fan and refrigerator motors produced by one manufacturer, from whom they have "authorization," they make themselves. During the winter, they did a nice business in servicing electric heaters.

Medical Equipment Needs Repair

There is a golden opportunity, they point out, in the servicing of electric equipment used by doctors. Locally, manufacturers' representatives formerly handled most of the maintenance on this type of apparatus. Now, the curtailment of transportation, and the induction into the armed forces of manufacturers' personnel, have opened up a new "market" for appliance servicing.

By advising physicians that its men are competent to make electrical repairs on medical apparatus Florida Appliance Service has picked up a good bit of this type of business. Solicitation of department, hardware, jewelry, drug and automotive-parts stores which sell appliances has added still further to the firm's volume.

Madden and Meyer, of Florida Appliance Service, divided a 20 ft. by 60 ft. building on a main traffic artery into a display room and work shop. The firm's name can be seen for blocks and the location is such that many customers can bring in and call for their appliances.

Madden and Meyer also construct certain types of special electrical equipment to order. A local company which made wooden fishing rods of high quality was having difficulty in baking them out sufficiently to prevent the flaking of finish lacquer. In order to solve this problem, Madden and Meyer designed a thermostatically-controlled oven which dehydrated the rods to a point where the lacquer no longer peeled off. Later converting to war-production work, the same company commissioned Florida Appliance Service to design and install special electro-plating equipment.

While catering to the repair of commercial and professional apparatus, the firm by no means neglects the servicing of household appliances. Part of Madden's time and that of two thoroughly-experienced men is devoted to restoring to usefulness ranges, refrigerators, washers, water heaters and small appliances.

When the Florida Power & Light Company's Miami branch discontinued its appliance-service department in July of last year, Madden and Meyer decided to pool their experience and their financial resources for the purpose of establishing a business of their own. As one of their initial steps, the two men selected as their base of operations a 20 ft. by 60 ft. store in the 700-block on West Flagler Street, one of Miami's principal east-west traffic arteries.

The space they acquired, Madden and Meyer divided into a 20 ft. by 40 ft. workshop and a 20 ft. by 20 ft. combination office and display-room. In the latter, they have a "lighting center" and a well-selected stock of small appliances. They also stock fluorescent lamps and service the fixtures.

Their shop reflects the impression of working efficiency which Madden and Meyer consistently have endeavored to create in the minds of their customers. A well-equipped bench, provided with plenty of outlets, extends almost the full length of the shop on one side. The wall on the other side is fitted with shelves and bins for storing replacement parts.

In order to avoid cluttering up valuable work-space, Madden and Meyer rented at small cost a nearby garage in which they store "junk" parts and old appliances that they have been able to obtain.

(*Continued on page 74*)

"Without exception, the properly designed starter can contribute more to the useful life of the Fluorescent lamp than any other accessory."

RIGID tests on delicate instruments such as the cathode-ray oscillograph have definitely proved that G-E Starters are properly designed to prolong the life of your fluorescent lamps and give more economical fluorescent lighting. For instance:

In all G-E Starters, preheating of the lamp electrodes is accurately timed to start the lamp at the right moment — not before, not after. This accurate timing conserves lamp emission material (vital to long lamp life).

In all G-E Starters, the constant breakdown voltage is maintained throughout the life of the starter at a point where it will not interfere with good lamp operation. Again, lamp life is prolonged through proper design.

It's not surprising, then, that enthusiastic users everywhere ask for G-E Starters when they want the best performance from their fluorescent lighting equipment.

WHEN BUYING FLUORESCENT FIXTURES—Insist that your fixtures have certified G-E equipment consisting of G-E Starters and Rotating Lock Lampholders, G-E Mazda F Lamps, and G-E Ballasts. It's the best way to buy "protection" for your fluorescent lighting equipment.

For complete information on G-E Starters and Rotating Lock Lampholders, write Section G 923-16, General Electric Company.

APPLIANCE AND MERCHANDISE DEPARTMENT, BRIDGEPORT, CONNECTICUT

GENERAL ELECTRIC

A steady stream of appliances for repair pass over this counter. The young lady is Mrs. Helen Barnes, daughter of the proprietor.

Even the Appliance "Freeze" Order Has Its Silver Lining

VIEWING the freeze order on the manufacture and sale of new electrical appliances as just another opportunity for service, Boggs Radio & Electric Service, Ensley, Ala., recently purchased and moved into a new brick home which affords three times as much room as in his old location. It is located on a street car stop corner with considerable value from an advertising standpoint.

Having gone through several ups and downs in the business curve since going into business in 1907, J. R. Boggs, proprietor, consequently holds no fear of the future. In fact, he sees an even greater opportunity to build up his repair service since new appliances cannot be bought and old ones will have to be maintained.

One good idea offered by Mr. Boggs to other repair shops for the mass collection and repair of electric appliances is as follows: first, circularize residents in a certain neighborhood, advising them that a service truck will be in that section within a week. For this purpose, the mailing list of the Birmingham Electric Company, which is cooperating with dealers in building up service business, is available. A return, self-addressed post card is enclosed, asking people with appliances needing repairs to notify the shop by mail.

Then at the appointed time, the truck makes the rounds of the neighborhood picking up crippled appliances. The service-salesman on the route also drums up business—first by telephone contacts, and then by direct calls in some instances. However, cold canvassing is not encouraged. If desired, the service man gives the customer a price on picking up the appliances, or telephones after the trouble has been located in the shop. Where there is no other understanding, the shop takes the appliances with the understanding that it will go ahead and make the repair, if feasible, and charge a reasonable price for the job. After the appliances are repaired, they are then redistributed to the proper homes, all in one trip. This saves time and equipment, and makes a pick-up and delivery service profitable.

Mr. Boggs said that except for this mass pick-up service, which is varied as between neighborhoods, customers are encouraged to bring their appliances in for repair and then pick them up. He estimated that a firm needs to charge about twice as much where an individual pick-up and delivery service is offered, and this may become impossible as trucks and tires wear out. However, in the case of major appliances, which this concern also repairs, it is not always possible for the customer to bring in the equipment. In case of refrigerators, re-

(*Continued on page 74*)

Interior view of the commodious display room showing small appliances.

Keep "Working Capital" Working!

By Arthur Roberts

This is one of a series of articles which will discuss various phases of business management from the viewpoint of the electrical contractor and appliance dealer. The first article of the series appeared in the December 1941 issue of this publication.

THE GOVERNMENT has clamped down hard on credit and according to some authorities, needless borrowing from any quarter may become non-existent.

This means just one thing for the electrical contractor and dealer. He must sustain himself with his own working capital to a greater degree than ever before, even in depression times.

From our accounting commitments in this field, we know that the majority of contractors and dealers never consider working capital, often do not know how to compute it but focus all attention on profits, sales and net worth, disregarding working capital entirely. Such action was loaded with plenty of dynamite in days BPH (Before Pearl Harbor) but today, it has dive-bomber repercussions.

We are reminded of a call we got early in 1941 to close the books for an electrical contractor-dealer who had gone into receivership. Local business men were surprised. From the outside looking in, he seemed to be prospering but a study of his financial statement, as of the date of receivership, revealed that he had gone blitzkrieg because he lacked working capital, which is the excess of current assets over current liabilities, a condition to guard against today. We realize that circumstances may force the contractor to go short on working capital, nevertheless, in many instances, he may be able to keep out of the danger zone if he watches this important factor in business management.

Working capital consists of two parts: cash assets, comprising cash and receivables, and trading assets or inventories. When cash assets equal current liabilities, your financial status may be considered satisfactory. Try to approximate this ratio at all times.

Dangerous Conditions Exist

In an analysis made in 1941 covering 23 financial statements of electrical contractors, we found that the current liabilities averaged 27 per cent more than their current assets, a dangerous condition, yet, these contractors thought they were sound financially because sales were good and net worth was substantial on paper. If cash and receivables exceed inventory, the working capital may be lower than if inventory exceeds cash and receivables, because there is more confidence in the liquidity of cash assets than in inventory. Inventory is subject to market fluctuations, customer acceptance and governmental restrictions, which may reduce its book value or limit marketability, whereas, cash and receivables are definite sums.

Although it is true that because of merchandise shortages, inventory may have a greater "forced sale" value today, no one knows what will happen tomorrow so it is wiser to stick to the old standards when computing working capital. No fixed ratio is recommended between cash and the other accounts but it is generally expected that the bank balance will run from 20 to 25 per cent of current loans.

For this contingency alone, William Mitchell, representing a typical contractor, should have had about $1,000 in the bank. His

WILLIAM MITCHELL, Electrical Contractor-Dealer
Financial statement as of April 1941, just before the receivership

Assets

Cash in bank	$ 109.13	
Petty Cash Fund	6.70	
Accounts Receivable	4,290.95	
Notes Receivable	2,535.30	
Inventories	3,570.17	
Total current assets		$10,512.25
Land for business purposes	$ 3,335.00	
Building for business purposes	6,085.00	
Showroom, office, shop fixtures and tools	1,015.00	
Service truck	515.00	
Total fixed assets		$10,950.00
Other assets		
Insurance deferred	75.00	
Investment in property for business expansion	665.00	
Total of other assets		740.00
Total of all assets		$22,202.25

Liabilities

Accounts Payable	$ 3,226.20	
Notes Payable to banks and others	4,683.20	
Deferred liabilities, including wages, interest and taxes	228.10	
Total current liabilities		$ 8,137.50
Fixed liabilities—mortgage payable		3,000.00
Total liabilities		$11,137.50
Net worth		11,064.75
Total liabilities and net worth		$22,202.25

balance sheet, a copy of which is shown here, lists $115.83 on hand and in bank. This balance sheet carries the same ratios as the statement reveiwed at the date of receivership mentioned heretofore. For ethical reasons, however, we have changed the figures slightly to avoid identification, and, of course, Mitchell is not his real name.

Effect of Seasonal Demands

The working capital may fluctuate with seasonal demands. In normal times, the contractor should see that working capital is high before heavy seasonal purchases so that he can stock up amply and take discounts. Lack of adequate working capital is one reason why many contractors and dealers pass discount dates and have no cash available to take advantage of attractive offers. They invest too heavily in fixed assets, or in other ways, impair working capital.

Often, this lack of funds isn't noticed until creditors press or business drops or reverses of one kind or another set in. Today, with merchandise hard to get, suppliers are taking a stiffer attitude toward credit, which is a good reason why contractors should watch their working capital closely because those who pay on the line are those who will get supplies if they are obtainable at all.

Where management is efficient, the working capital is usually in better conditions than where the reverse is true because loss leaks that impair working capital are kept at minimum. Where credit is granted promiscuously and collection procedure is below par, working capital is likely to be unsatisfactory. The capable business manager will keep sales moving so that cash keeps coming in consistently, he will estimate for profit and watch his costs. With appliance sales curtailed, he will push repair service to keep out of the red, all of which affects working capital favorably.

Mitchell's balance sheet shows $2,535.30 in notes receivable, $1,205 of which were unsecured and taken in lieu of payments on accounts receivable, which total $4,290.95. A ratio of about 25 per cent of unsecured notes to open accounts is too high. Ten per cent is considered deadline and it is better to scrap such practices, war or no war. In a business where notes receivable are seldom found on a balance sheet or are relatively high, their presence indicates a weak collection system.

Mitchell has a working capital of $2,374.75, the difference between $10,512.25 and $8,137.50, current assets to current liabilities, as shown on the accompanying balance sheet. If inventory and receivables were of ready liquidity, this contractor's working capital should have been around $8,000 with more than $1,000 in cash always on hand until the notes payable were paid off.

This would give what is known as a "current ratio" of about 2 to 1. Bankers and credit men consider that a contractor or dealer is financially sound if he can show this current ratio and this rule holds today as in peacetime.

This contractor, for his size, had an ample net worth on paper, but notice that he has set aside no reserves for depreciation, allowance for bad debts, loss on tools, or inventory. Inasmuch as he had been in business nine years, it least $3,000 should have been set aside for these expenses.

The size of the net worth is not the only yardstick for measuring the stability of an electrical contractor's business today. There are other factors, of which working capital is of prime importance. Working capital is like gas to a car. A business can't run without it. Mitchell made substantial profits during his business life and had acquired a tidy net worth even when reserves are deducted but sales began to dwindle in 1938 because lack of working capital was throttling operations.

This condition brought on other defects. He began cutting prices to get business, granted credit too freely to dubious accounts, gave excessive trade-in allowances, built up volume that was questionable, drew larger remuneration than conditions warranted, paid off $6,420 on the business property with a mortgage of $3,000 still outstanding, invested $665 in an adjoining lot for contemplated expansion, freezing his working capital in such over-expenditures for fixed assets and personal withdrawals instead of maintaining a safe margin for current obligations.

It is all right to acquire holdings for future expansion but it is dangerous to tie up excessive working funds in fixed assets. This impairs working capital because an over-investment in fixed assets means high fixed charges for taxes, upkeep, depreciation, etc.

The dependable contractor and dealer knows how to make profits and what to do with them afterward. On the surface, it seemed as though William Mitchell was prospering but each additional month brought him nearer to insolvency as creditors pressed harder, as upkeep on fixed assets mounted, as inefficient management kept sales in low and profits likewise.

The wise contractor works for his money and makes money work for him. Mitchell didn't play the game both ways. That is why he went with the wind. When analyzing your financial statement monthly, which, by the way, should be a "must" for the duration, consider working capital. It is a greater hazard to overlook it in these hectic times than when there was greater calm because heavy taxation and other costs are placing a tremendous strain on liquidity, not to forget credit restrictions. Try to keep enough cash on hand to meet all bills for at least 60 days.

Value of Working Capital Analysis

The analysis of working capital from month to month will keep the contractor posted as to whether this ratio is more or less favorable from period to period. Watching such trends is mainly the reason why the contractor should make comparative analyses of business operations and financial position regularly.

In seeking explanations of the movements pro and con, the contractor is in a position to take the necessary corrective measures or follow through along the proper paths. The most important consideration is whether you can meet your liabilities as they mature, including the anticipated pro-rata expense for taxes, and the device for measuring this capacity is the working capital ratio. The contractor can keep himself in the clear financially and go after maximum sales without being straight-jacketed for lack of funds if he watches working capital trends and maintains a safe ratio to requirements.

In normal times, and they will return again, so there is advantage in getting this earful now, the maintenance of an adequate sup-

(Continued on page 74)

NEWS of the INDUSTRY
National and Southern

War Problems Will Occupy IES Meeting

A multitude of war problems that the lighting profession can help solve, most of them concerned with the man behind the man behind the gun, will be discussed at the Wartime Lighting Conference of the Illuminating Engineering Society to be held in St. Louis, September 21 and 22.

Lighting for faster and better production, lighting for protection against the ever-present saboteur, acceptable substitue materials in lighting equipment, and blackout lighting —are a few of the subjects to be covered in the two-day convention. The conference will open Monday morning, September 21, featuring the president's address, by Willard C. Brown; a report of the Committee on Progress, by C. E. Weitz; and a discussion of alternate materials for luminaires, by E. H. Robinson.

A symposium on lighting for wartime production will occupy the entire Monday afternoon session. The program will include recommendations with particular reference to the war industries; lighting for the dairy manufacturing industry; a report of the I.E.S. Committee on light in wartime; an important investigation in the field of natural lighting; and a discussion of methods and equipment to foil the saboteur.

A Monday evening session, which will start at 7 o'clock, will include papers on how to obtain utilization factors in excess of 100 per cent through proper treatment of room finishes, and a discussion of war production plants with particular emphasis on lighting.

A technical session on Tuesday morning, September 22, will include discussion on the application of cold-cathode sources to interior lighting; photometric procedures and data on visibility of reflex reflectors; and luminescent paints and materials useful in the war effort.

A special luncheon meeting will be held Tuesday under the joint auspices of the I.E.S. Lighting Service Forum and the St. Louis Electrical Board of Trade. R. F. Hartenstein, chairman of the Lighting Service Forum, will preside over the meeting which will include a discussion of future lighting conditions and pertinent comments on war production rulings as they affect the lighting industry.

For Tuesday afternoon a defense committee session has been scheduled. This will be a unique, fact-finding session providing up-to-the-minute news and data in the interest of national defense, particularly with regard to blackouts and dimouts. The meeting will be concluded with the president's reception, banquet and dance to be held Tuesday evening.

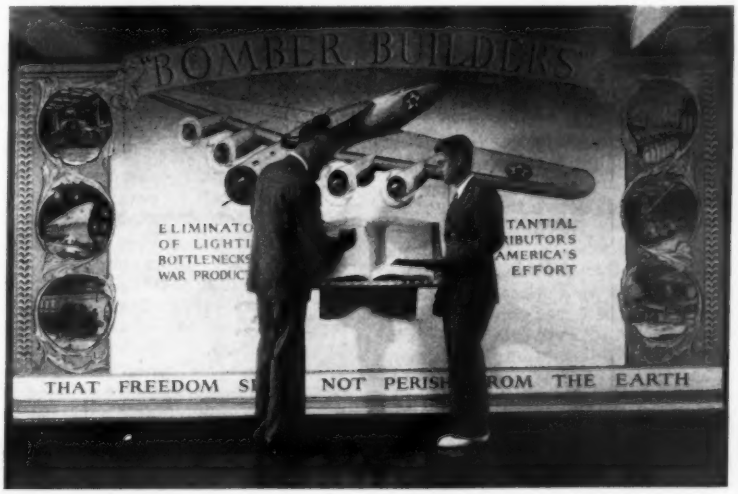
G.E. Sponsors Campaign to Blast Lighting Bottlenecks

Grim determination marked ceremonies attending official dedication in Cleveland, Ohio, on August 10, of an all-out nation-wide drive launched by the lighting industry "to eliminate from the war industry the thousands of lighting bottlenecks known to be seriously interfering with production."

This intensive wartime better-lighting crusade, an outgrowth of a successful bottleneck-smashing drive conducted by General Electric's lamp department soon after Jap Sunday, is designed to hammer away relentlessly at all lighting bottlenecks day in and day out for the duration. Its immediate goal is the addition of 600,000,000 man-hours annually in war industries from improved lighting.

Participating in ceremonies held in the G. E. Institute at Nela Park were representatives of the War Production Board, of the Ordnance Department, G. E. officials and other key men in the electrical industry.

Dramatic highlight of the occasion was a presentation of the electrical industry's newest and highest award —"in recognition of patriotic-plus aid toward improved war production"— to Frank E. Mueller, of the Cleveland Electric Illuminating Company. The award consisted of a citation coupled with a solid silver bomber decoration, for his coat lapel, given in recognition of his initiative in breaking lighting bottlenecks and for taking a sol-



Occupying a prominent place in the G.E. Institute at Nela Park, is this dramatic scene with a huge illuminated "Wartime Lighting Service Record" book as center of interest. This "shrine" will be used to record names of lighting men who distinguish themselves in an all-out nation-wide drive to eliminate from the war industry the thousands of lighting bottlenecks known to be seriously interfering with production. Left to right in the picture are L. C. Kent, who directs activities of G.E. Institute, and W. G. Darley, who will supervise judging of candidates' applications for membership in the bomber-builders' "club."

emn pledge designed to have him build at least one flying fortress!

Mueller was further honored by being the first to have his name inscribed in a huge illuminated "Wartime Lighting Service Record" book. The event took place in the G. E. Institute where the big book, in a shrine-like setting, will remain for the duration of the war. As other candidates qualify — candidates are divided into "craftsmen," lighting men on the firing line of the wide industrial front, and "organizers," the planners and directors of lighting bottleneck breaking activities— they too will be similarly honored.

Thousands of men on the industrial lighting front, it is expected, will presently have their names inscribed in the bomber tome of honor. The silver and gold bomber lapel pins will be emblematic not only of the patriotic spirit of these men but also of the extra amounts of war goods they personally have helped to create.

Ultimate goal set for this bomber drive is an annual creation of 600,000,000 added man-hours, said to be a conservative objective. Translated into more dramatic terms, this is the equivalent of 6,000 flying fortresses each costing $250,000, or more than 100,000 light tanks, or 250 destroyers, or 25 battleships.

The lighting experts point out that wherever lighting conditions are materially improved, production invariably is stepped up. In some cases, especially in the smaller ill-lighted plants, lighting has increased production 15, 25 and 30 per cent. That the goal set for this bomber drive is attainable seems probable. According to the campaign's sponsors, the 600 million additional man-hours goal may be gained if so little as a 3 per cent boost in production is achieved and if but one-half of the 20 million workers estimated to be now engaged in war production are affected by the upped illumination.

To be eligible for the gold bomber insignia, the aggressive lighting man need only prove that his efforts have resulted in the increase of 100,000 man-hours, for example, through better lighting in a war plant, or plants, where production has zoomed to 3 per cent above normal and where not less than 1,667 workers have been affected. As a double check on this merely multiply the 60 man-hours gained per man per year by the 1,667 men. The result is the 100,000 man-hours required to build one big bomber.

Vacuum Cleaner Replacement Program

Realizing that the curtailment of domestic vacuum cleaners places a definite obligation on cleaner manufacturers and offers an opportunity for their dealers and distributors to service and maintain cleaners in use in the American home, Landers, Frary & Clark, manufacturers of the Universal tank-type and conventional type cleaners have announced a new vacuum cleaner "Replacement Program" designed for distributors and dealers. The program is directed toward taking care of the anticipated increase in maintenance service.

PACKAGE REPLACEMENT PROGRAM—Twelve parts packages, three cleaners and five yards of bright red ribbon constitute an ideal display for the new Universal three point parts package Replacement Program. Realizing the importance of a tie-in between the new Universal parts packages and the Universal vacuum cleaners now in consumer use, the Promotion Department of Landers, Frary & Clark has set up a suggested display for service dealers offering the Universal Replacement Program. This display has been designed for use either in a window or showroom. Because of its simplicity and compactness it can be placed anywhere in the dealer's store without taking up too much room.

The new "three point" vacuum cleaner program embraces sales and service methods to cover the important types of servicing with which dealers and distributors will be confronted. The program which provides a public service during the war offers additional sales opportunity for dealers and distributors. This program backed by the nationally known Universal trade name keeps the factory authorized dealer in the public eye and steps up his service sales.

In this program, Landers, Frary & Clark offers to dealers for direct consumer sale two individual types of consumer parts packages containing the cleaner parts most frequently used. These parts packages retailing at $6.95 and $19.95 give every dealer an opportunity to profit from the increased demand for genuine factory parts which will keep thousands of Universal cleaners now in use in service. These two packages contain parts that require no specialized servicing.

The plan also includes a method of establishing a special service station for dealers who are prepared to make mechanical repairs and to rebuild customers' cleaners. Complete information regarding this plan is outlined in material that may be secured by writing to Landers, Frary & Clark, New Britain, Conn.

Lighting Program Planned For Utility Companies

Maximum utilization of existing lighting facilities is the theme of a wartime promotional program for public utilities released by the Lamp Division of the Westinghouse Electric and Manufacturing Company. Divided into three sections, homelighting, industrial lighting and institutional advertising, the promotional literature points out the nature and extent of the vital job good lighting is doing to help win the war.

An outstanding feature in the program is a booklet "Keeping the Blackout Outside Your Home," which tells how to equip the home with proper blackout precautions without interfering with regular, adequate

When you tackle WAR PLANT LIGHTING PROBLEMS

. . remember the OFFICE

. . . with fluorescent by WAKEFIELD

Sure they need better light in the shop! *But office workers and draftsmen need good light too,* . . . to move today's heavy paper work faster . . . help keep production lines rolling.

See how Grenadiers, topnotch Wakefield fluorescent fixtures, give people in this office shown above, light for easier, faster seeing . . . light to help cut down errors and maintain peak efficiency longer.

Help your customers gain these advantages! When you plan new or conversion war plant lighting jobs, remember the office and drafting room with fluorescent by Wakefield.

NOTE: To speed delivery, see that standard Wakefield units are specified. "Special" jobs take longer.

The GRENADIER . . . Efficient 2-lamp unit. Provides smooth, diffused overall light. Plastic inserts on sides greatly reduce use of critical materials and weight. Units may be mounted end-to-end as suspended troffers. Reflecting surfaces face downwards, catch less dust; re-lamping is easy.

The ACE . . . Tops for high intensity downlight or where rooms have poor ceilings. Puts 90% of its light down on desk-top or board. A small amount of light upward prevents eye-straining contrasts. Adequate louvers assure smooth, diffused light. Narrow 3-inch depth adds to its trim appearance. Easy maintenance and relamping.

And they're both Certified FLEUR-O-LIERS!

THE F. W. WAKEFIELD BRASS CO.

92 SOUTH PARK — VERMILION, OHIO

lighting. Simple directions, for preparation of inexpensive curtains made of cloths, blankets, wood or paper, are given. Additional folders explain the proper care of lamps and fixtures and the importance of "better light for better sight."

Application of the "right amount of light at the right place" is the key to the program's industrial lighting section, which tells how to speed America's battle of production with better lighting. Use of the proper type of illumination, size of bulbs and reflectors, correct location of fixtures and a regular lighting maintenance program—all are described as essential to improving quality of workmanship in American factories, reduction of accidents, decreasing spoilage and protection against sabotage.

A series of eight institutional advertisements have been prepared for placement in local publications and all are aimed at maintaining and building the prestige of public utilities as a significant force in the war effort.

Electrical Inspectors To Meet in Richmond

Members of the Southern Section, International Association of Electrical Inspectors, will hold their annual meeting at Hotel John Marshall, Richmond, Va., on October 19, 20 and 21. The program for the business sessions will be devoted almost entirely to discussions of the conditions in the electrical industry resulting from the war program. It is anticipated that the supplement to the National Electrical Code, which is just going to press, will be available just before the Southern Section meeting. The Interim Amendments to the National Electrical Code, which will be published in the supplement, will provide a basis for considerable discussion at the meeting.

The Monday morning session will be featured by addresses by the international president, W. L. Gaffney, of Tacoma, Washington, and the Southern Section president, W. A. Stahl, of Jacksonville, Florida. Also at this session will be heard reports from the international secretary, V. H. Tousley, of Chicago; the Southern Section secretary, C. M. Jones, Atlanta; the executive committee, headed by E. C. Knox, of Miami.

At the Monday afternoon session, E. S. Fitz, of Virginia Electric & Power Company, will discuss "The Importance of Electricity in the War Program." Alvah Small, president of the Underwriters' Laboratories, Inc., and chairman of the electrical committee, NFPA, of Chicago, will follow Mr. Fitz on the program speaking on "The National Electrical Code and Its War-Time Program." Other subjects to be discussed at this session will include "Government Specifications and the Effect of War Production Orders on Electrical Work," and "Plant Protection in War Time."

The greater part of the business sessions on Tuesday and Wednesday will be devoted to code discussion following the procedure adopted at the last meeting of the Southern Section. Under this plan, a code discussion panel will be provided to offer solutions to any code problems that may be brought up. The panel members include the following: Frank Camus, chairman, C. M. Jones, secretary, H. H. Weber, L. F. Adams, Arthur L. Abbott, James S. Mahan, M. M. Brandon, J. G. Fisher, George Welman, Victor H. Tousley, Frank Thornton, B. Z. Segall, E. C. Knox and W. A. Stahl.

Among the addresses to be heard during the last two days of the meeting will be "Substitute Materials and Their Uses," by M. M. Brandon, Underwriers' Laboratories, Inc., New York; "Legislative Activities," by G. A. Sawin, of NEMA, New York; "More Wires and Conservation of Steel," by Joseph Siddalls, H. H. Robertson Company, Pittsburgh.

The John Marshall Hotel, headquarters for the Southern Section annual meeting in Richmond, offers many conveniences to add to the comfort of Southern Section members. It is located in the heart of the theater and shopping district, within walking distance of many historical shrines, and includes an air-conditioned coffee shop and seafood grill that have won a reputation for their fine southern cooking. The spacious Virginia Room, the convention auditorium, is also air-conditioned.

GECC Offers Contractors New Finance Plan

Some capable contractors have avoided bidding on government contracts because they felt they had insufficient working capital. While they could arrange credit for necessary materials this did not answer the problem of meeting heavy weekly payrolls.

General Electric Contracts Corporation has recently extended a plan to the Southeast that should permit contractors to enter bids for contracts within the limits of their own capabilities rather than the amounts involved, according to announcement by Pete Thompson, district manager of the Contracts Corporation.

W. J. Plunket

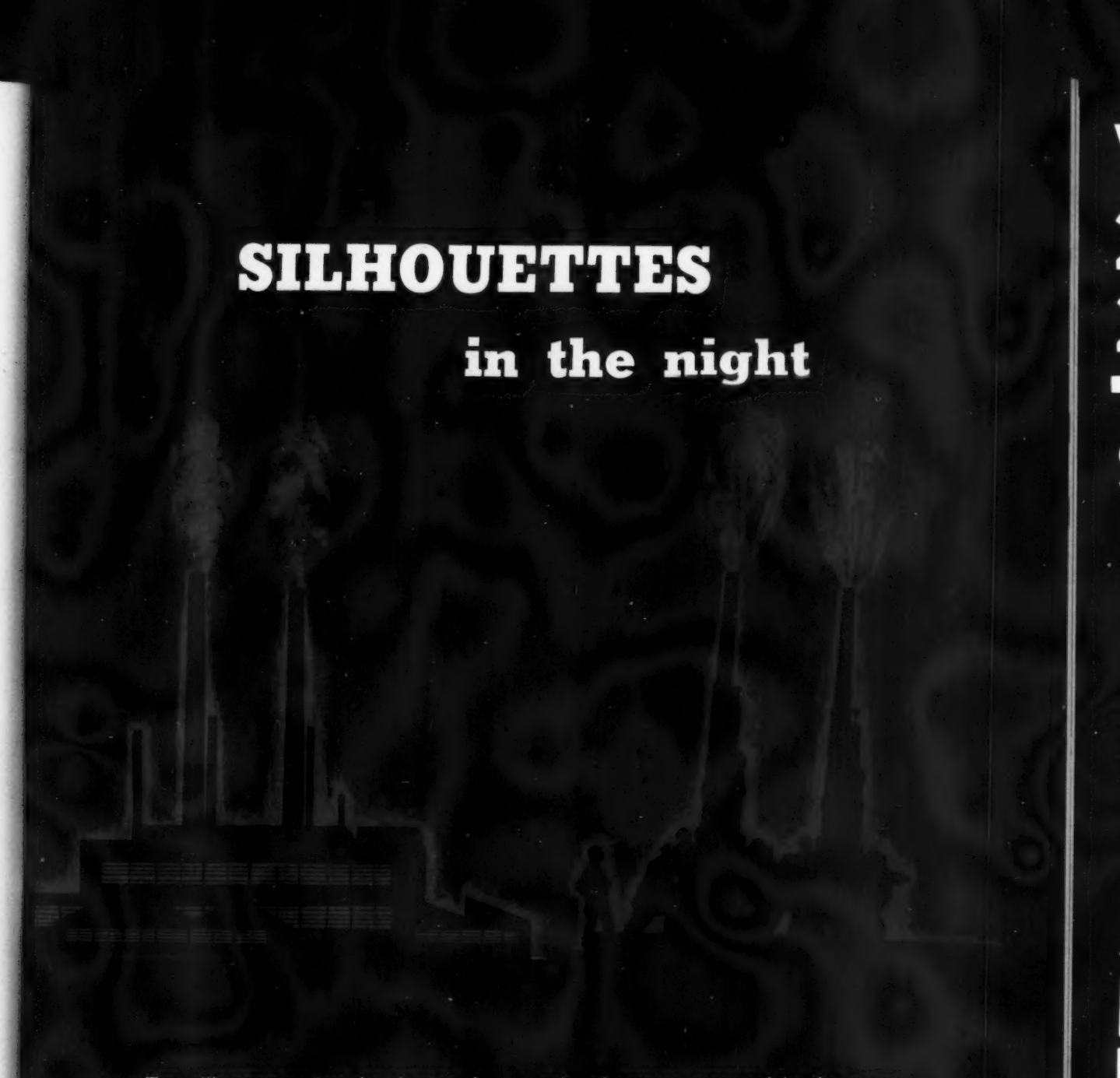
The plan, briefly, is as follows: the contractor makes his connection with G.E.C.C. and the amount of money required to finance the project is agreed upon. The contractor arranges to assign the proceeds of his contract to G.E.C.C., and G.E.C.C. will then pay all material invoices and advance moneys for payrolls as required.

The charges for the service are reported to be reasonable and in many instances the savings to the contractor because of cash discounts obtained on material purchases will approximate the total cost of the service.

When the job is completed and proceeds of the contract have been received, G.E.C.C. will immediately make a complete settlement of the transaction deducting the agreed upon charge.

W. J. Plunkett, of the General Electric Contracts Corporation's district office in the Red Rock Building, Atlanta, Georgia, is in charge of the application of the new plan in the Southeast.

SILHOUETTES
in the night



Two silhouettes against the glowing sky, so similar in appearance and purpose, yet so vastly different in character.

The one is a factory, with chimneys belching smoke and fire, evidence of the productive energy beneath, working night and day to feed the cannons of our fighters.

Much more difficult a task, with many lives held in the balance, is that of the men behind the gun. Every flash, every rumble echoes a unity of purpose supported by the greatest single group in the history of the world. One object! Simply stated, but of colossal import. "Win the war!".

Two silhouettes against the sky. One is a symbol of the country's productive effort of which you and we are a part. We are pleased to place our facilities completely at the disposal of our government. We are proud that it is in our power to help the boys whose forms are outlined in that other silhouette.

"HANG THE LOAD ON HUBBARD HARDWARE"

HUBBARD AND COMPANY

PITTSBURGH OAKLAND CALIFORNIA CHICAGO

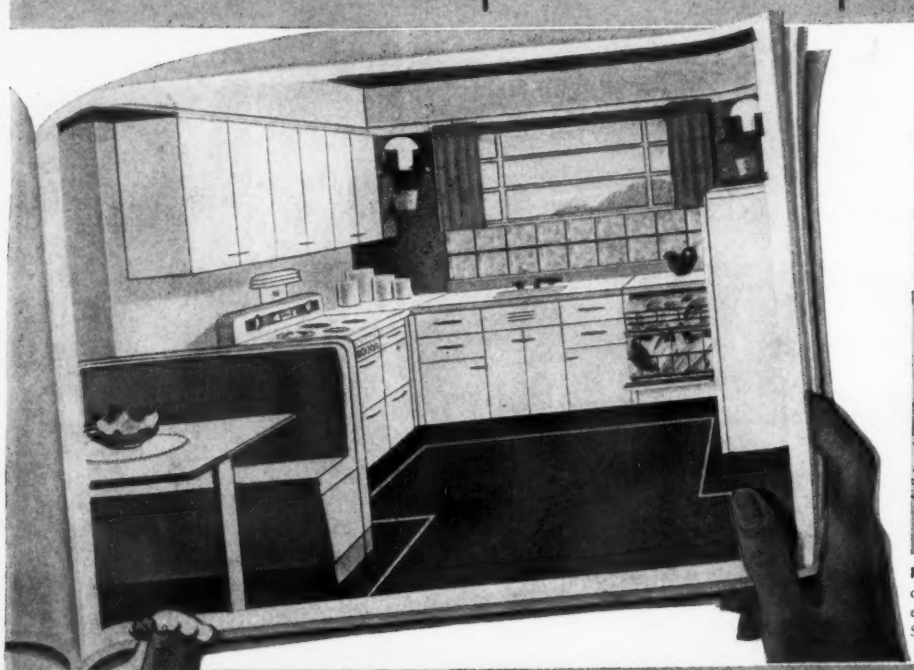
Hotpoint ANNOUNCES

Our New HOTPOINT ELECTRIC KITCHEN
Is Just Around the Corner...

EVERY DOLLAR I spend for War Bonds gives me a great big thrill of satisfaction! I figure I'm not only helping win the war but hastening the day when I'll be able to own the kitchen I've always dreamed about—a Hotpoint Electric Kitchen like Jane's. You can't *imagine* how much actual time and work it saves her every single day—how amazingly easy it is to keep clean—how delightfully cool it always is!

. . . and Boy, It's a Beauty!

The cost of a Hotpoint Electric Kitchen averages about 10% of home-building costs.



I never realized that a practical Hotpoint Electric Kitchen could be so handsome! It's certainly a beauty—every gleaming inch of it! And best of all—it costs far less than we ever thought

FOR A $6,000 HOME—The Colonial Kitchen (left), complete with Hotpoint Range, Refrigerator, Electric Dishwasher, Sink and Hotpoint Steel Cabinets, costs so little that many $6,000 homes now enjoy them.

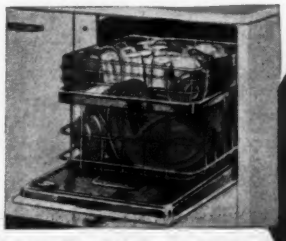
FOR A $4,000 HOME—The Sunset Kitchen (above), one of *thousands* installed in low-cost defense homes, equipped with Hotpoint Range, Refrigerator, Hotpoint Sink and Steel Cabinets.

BUY WAR BONDS TODAY—ELECTRIC KITCHENS TOMORROW

This advertisement in full colors, and others of similar type will appear in the following publications:

PUBLICATION	ON SALE	ISSUE
Electricity on the Farm	September 1	September
Collier's	September 11	September 19
House Beautiful	September 18	October
Better Homes and Gardens	September 25	October
American Home	September 25	October
Electricity on the Farm	October 1	October
House Beautiful Maintenance and Building Manual	October	Fall & Winter
Life	October 9	October 12
Collier's	October 9	October 17
House Beautiful	October 19	November
American Home	October 23	November
Electricity on the Farm	November 1	November
House Beautiful Guide for the Bride	November	Fall & Winter
Life	November 6	November 9
Bride's Magazine	November 15	November 15
Collier's	November 20	November 28
Better Homes and Gardens	November 25	December
Life	December 4	December 7

far longer in Refrigerator. conomy right avings we will in quantities!



● Even the children can operate a Hotpoint Automatic Electric Dishwasher and Disposall. Just a flick of the switch and dishes are washed sparkling clean—food wastes flushed away.

Hotpoint ELECTRIC KITCHENS ★ ★ ★

WEST TAYLOR STREET, CHICAGO, ILL.

N IMPORTANT CONTRIBUTION TO AMERICA'S WAR EFFORT

...and a Plan for the Future!

R HEART'S IN THE WAR BUT OUR EYE IS ON PEACE

A DOUBLE-ACTION PROGRAM

To Sell War Bonds NOW

Hotpoint's new advertising program is designed to tell the American people that the money they invest in War Bonds today renders double service. It helps Uncle Sam buy the materials of War now, and provides a fund with which buyers of bonds may finance the products of peace, after the War. It provides added incentive for buying War Bonds; gives a good reason for saving.

To Finance Post-War Purchases

While Hotpoint's facilities are converted to War production the day will come when our dealers, distributors, and customers will turn back to peace-time business. Meanwhile Hotpoint's War Bond advertising is telling your prospects and customers to buy more War Bonds with which to finance the purchase of a new Hotpoint-Electric Kitchen after the War is won.

How You Can Help—

Hotpoint's new wartime program is for you. The plan book "Maybe Tomorrow" explains every step and shows mailing pieces, newspaper advertisements and the novel Home Planning File. Ask your Hotpoint Distributor for details. This program enables you to urge your customers to earmark their War Bond Savings for Hotpoint appliances after the War.

Home Planning File

Makes it easy for your customers to file and save ideas for the home they plan to build after the War. Keeps your name constantly before them.

Washington Likes This Cooperation

Hotpoint's War Bond advertising program is doing a vital job for Uncle Sam. It gives a new dimension, an added reason why people should *buy more War Bonds and keep them.* Officials at Washington are pleased with the idea.

Follow through locally by using Hotpoint's mailing pieces, Home Planning File and newspaper ads. Uncle Sam will appreciate your effort.

EDISON GENERAL ELECTRIC APPLIANCE CO., Inc., 5614 West Taylor Street, Chicago, Illinois

REFRIGERATORS
RANGES
WATER HEATERS
WASHERS AND IRONERS

Hotpoint

ELECTRIC KITCHENS

CLOTHES DRYERS
AUTOMATIC DISHWASHERS
ELECTRASINK
STEEL CABINETS

Electric Meter Production Curtailed for Duration

Production of the common household electric meter will be curtailed for the duration under an order issued recently by the War Production Board. At the same time, restrictions on deliveries to take effect immediately were ordered.

General Limitation Order L-151 provides that manufacture of all so-called "domestic watthour meters" are to be prohibited after September 26, 1942. Production of meters in the interim is restricted to two and one-half per cent of the total number of meters manufactured by any producer during the entire calendar year 1941.

This action is expected to make available about 750,000 pounds of copper for military purposes at current rates of production. In addition, approximately 3,000,000 jewels of an industrial type will be made available for precision instruments used in military operations. Approximately 2,000,000 meters of all types were manufactured last year.

Existing meter manufacturing facilities will be converted to production of precision-type combat instruments, gauges, measuring devices, etc., for the Army and Navy.

* * *

The electric motor and control section of the general industrial equipment branch of WPB has announced that henceforth new motors will be released only for the most important war and civilian requirements. Other applicants for new motors will have to adapt used equipment to their needs. In general, large motors of any kind—used or new—are not available for other than war or essential civilian purposes.

At the same time, in a broad move to conserve materials, production capacity, and manpower in the electrical goods manufacturing industry, the electric motor and control section announced that it is requesting producers to undertake a voluntary simplification program covering types and designs of motors. "Overloading" of present equipment beyond its rated capacity will be an integral part of this program.

In order to have a complete file showing all available used motors in the country, the WPB has asked that owners of motors adapted for commercial purposes communicate with the conservation division, used-equipment section, giving all relevant information.

Hygrade Sylvania Changes Name

Stockholders of Hygrade Sylvania Corporation, meeting at Salem, Mass., July 30, acted to change the name of the corporation to "Sylvania Electric Products, Inc." The new name became effective August 12, 1942.

It is planned to use the trade name "Sylvania" on all the company's products. This change will be made as rapidly as is consistent with economies of operation and the conservation of materials.

San Antonio Utilities Purchased by City

The City Council of San Antonio, Texas, meeting in special session July 25, voted to issue $35,000,000 in revenue bonds for the purchase of all San Antonio Public Service Company properties and passed regulations providing for the operation of the utility system. Complete control and management was lodged in the hands of a five-member board of trustees composed of D. F. Youngblood, W. B. Tuttle, Franz C. Groos, Walter P. Napier, and the mayor as an ex-officio member but with voting power. The board of trustees is to name a general manager, who will receive an annual salary of $12,000, and is to appoint all officers and employees to operate the utility.

The bonds will mature over a 30-year period. First revenues each year from operation of the gas and electric systems in the San Antonio metropolitan area are to be used to pay current operating expenses, insurance and expenses of maintenance and repair. Next available revenues will go to meet principal and interest payments on bonds with an additional 20 per cent being set aside each year for accumulation of a reserve fund. Remaining revenues will be received by the city and the San Antonio Independent School District in lieu of taxes that would be paid if the utility systems remained in private hands.

Col. W. B. Tuttle, member of the board of trustees, was for many years president of the San Antonio Public Service Company, and more recently, was chairman of the board of the company.

Standards Issued on Service Equipment

The National Electrical Manufacturers Association announces the release of a new publication entitled, "Service Equipment Standards."

The new handbook incorporates general, performance, rating, marking and test standards for devices such as service entrance and meter service switches, service circuit breakers, meter test blocks and combinations of meter service switches and branch circuit fuse holders or branch circuit breakers.

Copies may be obtained from NEMA headquarters at 155 East 44th Street, New York, N. Y. The price is 30c per copy.

Meetings and Conventions

Sept. 17-18, **International Association of Electrical Inspectors** (Northwestern Section), Portland, Oregon.

Sept. 21-23, **International Association of Electrical Inspectors** (Southwestern Section), Fresno, California.

Sept. 21-22, **Illuminating Engineering Society,** Hotel Jefferson, St. Louis, Missouri.

Oct. 4-7, **International Municipal Signal Association, Inc.** (47th Annual Meeting), Benjamin Franklin Hotel, Philadelphia, Pennsylvania.

Oct. 5-7, **International Association of Electrical Inspectors** (Western Section), Book-Cadillac Hotel, Detroit, Michigan.

Oct. 5-9, **31st National Safety Congress & Exposition of the National Safety Council,** Stevens Hotel, Chicago, Illinois.

Oct. 12-14, **International Association of Electrical Inspectors** (Eastern Section), New Haven, Connecticut.

Oct. 19-21, **International Association of Electrical Inspectors** (Southern Section), Richmond, Virginia.

Oct. 26-30, **National Electrical Manufacturers Association** (Annual Meeting), Waldorf-Astoria Hotel, New York, New York.

Oct. —, **National Electrical Wholesalers Association** (Semi-Annual Convention).

Nov. 30-Dec. 1, **National Industrial Council,** Waldorf-Astoria Hotel, New York, New York.

Dec. 2-4, **National Association of Manufacturers** (Congress of American Industry), Waldorf-Astoria Hotel, New York, N. Y.

1943

Jan. 25-29, **American Institute of Electrical Engineers** (Winter Convention), Engineering Societies Bldg., New York, New York.

May 10, **National Fire Protection Association,** Palmer House, Chicago, Illinois.

June 21-25, **American Institute of Electrical Engineers** (Summer Convention), Cleveland, Ohio.

Oct. 25-29, **National Electrical Manufacturers Association** (Annual Meeting), Waldorf-Astoria Hotel, New York, N. Y.

Enginemen Needed for Federal Building Plants

Enginemen (steam-electric) are needed to be in charge of heating, refrigerating, and ventilating systems in Federal buildings in Washington, D. C. The United States Civil Service Commission is recruiting enginemen for positions paying from $1,680 to $2,040 a year.

There is no education requirement. There are no age limits. Filing application forms, obtainable at first- and second-class post offices, is all that is necessary to be considered. Applications must be filed with the Civil Service Commission, Washington, D. C., and will be accepted until further notice. Qualified persons are urged to apply at once.

SPERO

QUALITY 5 LINES

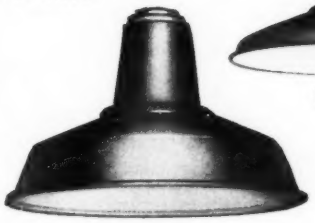
KEEP DEPENDABLE LIGHT ON OUR WAR EFFORT

Many plants building for Victory are using all of the Spero 5 Quality Lines — saving time because deliveries of each line can be coordinated— to eliminate waiting for shipments from separate suppliers. Write today for information.

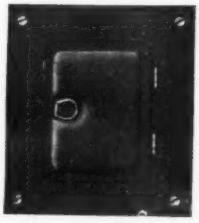
★ NO. 2100G

NO. 212 ★

★ INSULATOR NO. 1410



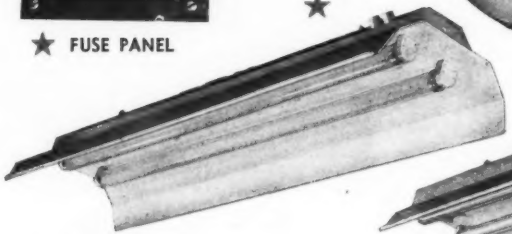
★ NO. 512



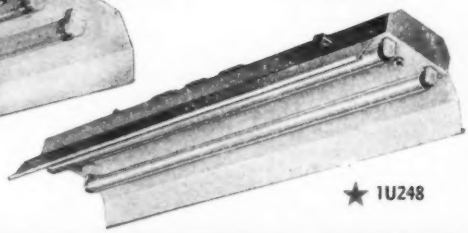
★ FUSE PANEL

SWITCH PLATE NO. 302 ★

NO. 675L ★



★ 1U260



★ 1U248

Light is Essential to Victory

THE SPERO ELECTRIC CORPORATION

1822 LANKEN AVENUE ★ CLEVELAND, OHIO

Amendments to National Electrical Code Approved

The Chairman of the Electrical Committee, NFPA, A. R. Small, has announced that Tentative Interim Amendments to the National Electrical Code—Nos. 44 revised, 53, 54, 56, 61 and 63 to 67 inclusive—have been approved by letter ballot and are recommended for application in the administration of the Code.

Amendment No. 44, revised, provides for wires of "other types specially approved for the conditions" as an alternative to slow-burning weatherproof and weatherproof for use as the grounded circuit conductor; and also changes the circuit voltage from 208 volts to ground, to 600 volts to ground.

Amendment No. 53 provides for grounding the frames of electric ranges to the grounded circuit conductor under certain conditions.

Amendment No. 54 is a revision of Section 2560 (formerly Section 2559) to provide for using the grounded conductor of the service for grounding meter housing and service equipment.

Amendment No. 56 provides for recognition of No. 20 B & S gauge flexible cord for certain uses. In connection with this item, NEMA will propose an additional Interim Amendment to provide that the rating of 20 B & S gauge flexible cord shall be not more than 3 amperes.

Amendment No. 61 is a revision of Section 6112 to provide for higher current ratings of conductors when they are used on circuits supplying crane motors, such motors having a duty which is extremely varying in load and time of application.

Amendment No. 63 revises Section 3004 and provides revised ratings for conductors having varnished cambric or asbestos-varnished cambric insulation under the condition that the circuit is not operated continuously at maximum current. This is somewhat similar to Interim Amendment No. 41 for Rubber Covered Conductors.

Amendment No. 64 cancels Interim Amendment No. 45, and revises existing Section 3203 and the Table of Section 3005 so as to remove the lower temperature limit for conductors having slow-burning or slow-burning weatherproof covering.

Amendment No. 65 revices Section 2357 to provide a new basis for determining the minimum rating of the service switch.

Amendment No. 65 revises Section inition for "continuous operation" as referred to in Interim Amendment No. 41 which covers the ratings of rubber-covered wires which are used on non-continuous service.

Amendment No. 67 deletes Section 2452 from the Code for the duration of the war. This Section formerly made it mandatory that plug fuses be Type S.

PERSONAL NOTES
About Men You Know

P. C. Sowersby, assistant advertising manager for General Electric Lamp Department, at Nela Park headquarters, in Cleveland, has been transferred to the company's Michigan Division, in Detroit. Mr. Sowersby will specialize in the advancement of wartime lighting designed to increase production of war goods manufactured in the Michigan industrial area.

Widely known throughout the electrical industry, especially by advertising men and magazine editors, Mr. Sowersby more commonly answers to the name "Phil." After graduating from Oregon State College with the degree of Bachelor of Science in Electrical Engineering in 1927, he joined General Electric, at Schenectady, N. Y. During his eleven years there he was active in radio sales, in publicity and industrial advertising work.

Mr. Sowersby transferred to the lighting branch of the company at Nela Park in 1938. As assistant advertising manager, he personally contacted trade magazine key men in various sections of the country, serving as idea-man for numerous advertising and promotional activities originating at Nela Park. He is a prominent member of the Industrial Advertisers Association, served for four years on the Board of Governors of the Industrial Marketers of Cleveland, and for two years was president of Theta Xi fraternity. He is recognized as a crack golfer, having broken par over the difficult Manakiki course in Cleveland where he has been a member for several years.

P. C. Sowersby

* * *

Capt. Sam M. Sharp, chief engineer for Southwestern Gas and Electric Company, was called to active duty with the U. S. Army and ordered to report at Barksdale Field from where he was sent to Fort Monmouth, N. J., July 17. Capt. Sharp has held a reserve commission in the Signal Corps for several years and was called to active duty in that branch of the service. He served in the first World War from 1917 to 1918, and has been with Southwestern Gas and Electric Company and associated companies since 1926.

Richard P. Smith, promotion manager of "Electrical South" and vice president of the W. R. C. Smith Publishing Co., of Atlanta, Ga., reported for duty recently as a first lieutenant in the Quartermaster Corps of the Army of the United States. For the present, Mr. Smith, who is the son of the late W. R. C. Smith, founder of the company that bears his name, will be stationed in Washington, D. C.

Loyd T. Williams, employed in the engineering department of Southwestern Gas and Electric Company for several years, has been named acting chief engineer to succeed Mr. Sharp. Mr. Williams, who first became associated with the company in 1924, became assistant engineer in the building of the 66 kv transmission line from Shreveport, Louisiana, to Texarkana, Ark.-Tex. He then became a member of the Shreveport engineering department.

S. M. Sharp

L. T. Williams

(Continued on page 74)

America is now thoroughly awake to the seriousness of what lies ahead. There is a definite realization that we can lose this war if we do not take advantage of every one of our national resources.

The sources of virgin raw materials, -- ore mines, coal mines, mines from which alloying materials are produced -- are being drawn upon to their limit. But now the steel industry, in order to produce the necessary steel for tanks, guns, planes, ships, shells, bombs, machines and other vital war material, needs 6,000,000 tons of scrap in addition to the regularly available supply to achieve its goal.

The extra supply of iron and steel scrap is largely beyond the control of our industry -- it is in the hands of more than a hundred million Americans. In order that ultimate Victory may be assured, every individual must adopt an objective, fact-facing attitude and pledge himself to help in the mobilization of every pound of iron and steel scrap and make it available, through regular channels, in order that it can be converted into prime steel.

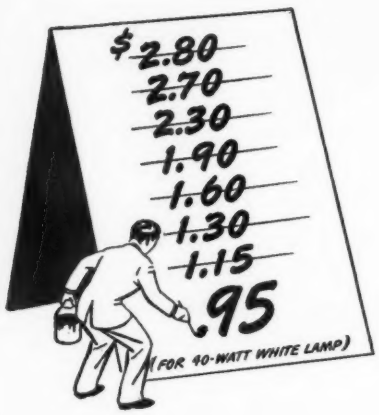
This Advertisement Sponsored By

THE YOUNGSTOWN SHEET AND TUBE COMPANY
YOUNGSTOWN, OHIO

In Cooperation With The U.S. Government Salvage Campaign

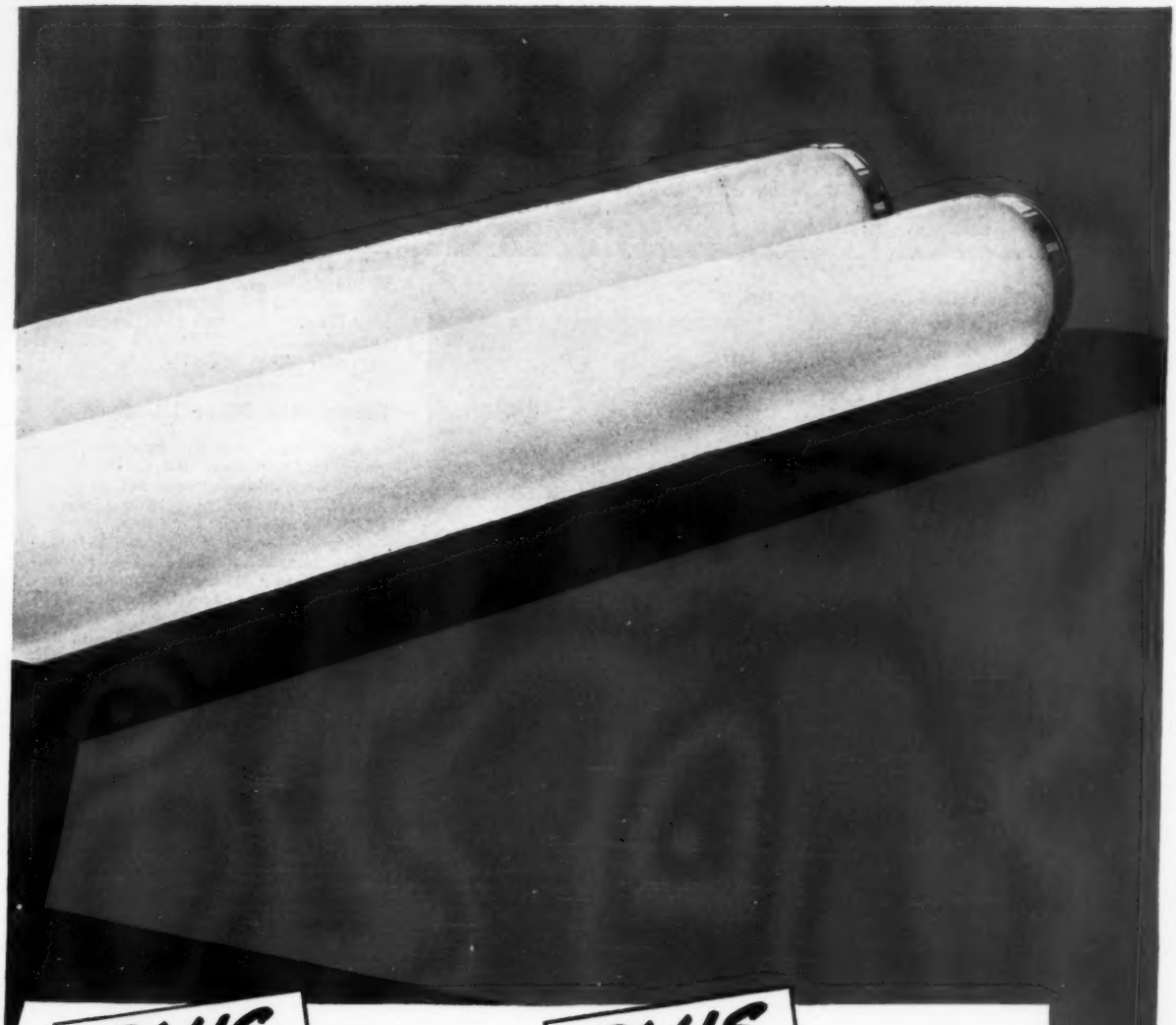
Again Westinghouse Reduces Prices!

7 times in 4 years!



This is the kind of news you don't expect to hear today. And it's good news for every user of fluorescent lamps. Prices have been reduced 12% to 17%, giving you even lower lighting costs, even more light for your money. Here again is proof of Westinghouse leadership in lamp design, research and manufacturing know-how. But lowered prices are not all. Quality has been substantially increased too. Today Westinghouse Mazda lamps give more light, last longer and cost less.

It's Westinghouse for



PLUS

In 1939 1880 LUMENS Now 2100 LUMENS

12% Brighter Light

Technical improvements give you brighter light—in the 40 watt white lamp, for example, brightness is increased from 1880 to 2100 lumens —almost 12% more light for your money.

PLUS

A thousand Extra Hours of Life

In addition to lower costs and brighter light, Westinghouse fluorescent lamps now last longer than ever before—40 watt white lamps now have a rated life of 2500 hours —an increase of 1000 hours.

In 1939 1500 hrs. now 2500 hrs.

FLUORESCENT

New low prices, on Westinghouse Mazda Fluorescent Lamps, effective September 1st

14-watt T-12 reduced from 80c to **70c**
15-watt T-12 reduced from 80c to **70c**
30-watt T-8 reduced from 80c to **70c**
15-watt T-8 reduced from 65c to **57c**
20-watt T-12 reduced from 80c to **70c**
40-watt T-12 reduced from $1.15 to **95c**
100-watt T-17 reduced from $2.60 to **$2.15**

The above prices are for daylight and white lamps.
Prices on Westinghouse soft white and colored fluorescent lamps are also reduced.

Prices on MAZDA H (MERCURY) also Reduced

400-watt T-16 AH1 reduced from $11.00 to $9.50
400-watt T-16 BH1 reduced from $11.00 to $9.50
3000-watt T-9½ AH9 reduced from $45.00 to $40.00

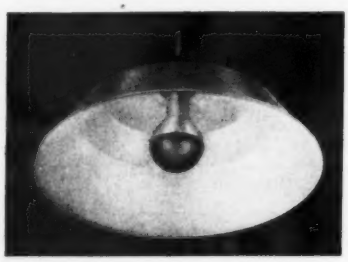
Better Light at Lower Cost

NEW EQUIPMENT and MATERIALS

Silvray Speed-Lights

The importance of "better seeing" in war plants coupled with the necessity for economy in the use of vital materials was instrumental in the producing of Silvray Speed-Lights for industrial lighting, which will be distributed nationally by the Graybar Electric Company.

This unit is designed for use with silvered bowl Mazda lamps. It has the filament completely shielded and permits the use of large lamps to obtain high intensity lighting with complete elimination of glare. It delivers the kind of light needed for super-production jobs.

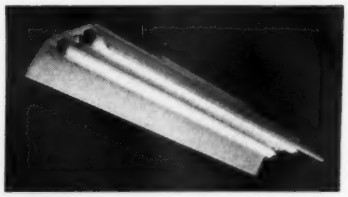


The reflector, requiring the use of only light gauge metal, is simple in design and the large area provides excellent diffused illumination. Installation can be made quickly, and once installed, maintenance problems are gone, due to the fact that there are no parts to get broken or be replaced. The units need no servicing other than occasional cleaning of reflecting surface and the periodic replacement of the silvered bowl Mazda lamps.

Widely applicable to present outlet spacing, the Silvray Speed-Lights are available for use with 150, 200, 300, and 500 watt bulbs. The finish of the reflector surface is flat white-high efficiency polymerin, the exterior is battleship gray enamel.

Air-Cooled Ballast

The Electric Corporation of America, Chicago, Ill., recently announced a new air-cooled ballast for fluorescent lamps. The aereated ballast is equipped with fins which provide a larger cooling surface. When mounted externally, the manufacturer reports that the ballast temperaure is much lower than that normally experienced with this type of device. Other advantages claimed for the new air-cooled ballast are lower hysteresis losses; longer life resulting from lower temperature; lower noise level; better voltage regulation; and lower maintenance cost.



Illustrated here is the Electric Corporation's model 1517 industrial fixture. Among the advantages listed by the manufacturer for this new fixture are: utilization of the new air-cooled ballast; simplified reflector assembly which permits reflector to be removed without disturbing position of fixture or electrical connections; replaceable starters; readily accessible wiring requiring the removal of two thumb screws in order to expose wiring channel for easy maintenance; and directional suspension which makes it possible to install the fixture at any angle by shifting S-hooks from one hole to another.

New Curtis Catalog

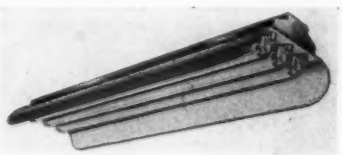
Curtis Lighting, Inc., is now distributing its new 88-page Catalog 42, describing up-to-date equipment offered to the trade.

Catalog 42 contains specifications, footcandle data, co-efficients of utilization charts, equipment spacing and all other information essential for ordering and installing fluorescent and incandescent lighting. To accompany this catalog, a special complete price list has been compiled for convenience in locating the prices on the various types of unit mentioned.

Copies of the new catalog will be sent upon request to Curtis Lighting, Inc., Chicago, Ill.

Day-Brite Luminaire

Day-Brite Lighting, Inc., of St. Louis, announces a new development in their recently introduced Day-Line industrial lighting fixture line. In place of the steel usually used in the manufacture of the porcelain enamel reflectors of these fixtures, they are now using a pressed-board that is given a 325° baked enamel finish. According to recent tests, reflection factors of well over 81 per cent have been obtained and a savings in steel of over 64 per cent is realized through the use of these new reflectors.



This new line includes standard Day-Line servicing and installation features such as simple removal of reflectors and lamp starters and the easy application of various methods of suspension including the unique "ice-tong" channel clamp which materially simplifies installation.

This new set-up is available in single units and continuous fixtures and is referred to as the "V-Series Day-Line." Bulletin F-61 containing complete information and prices is available upon request.

Fluorescent Floor Display

A colorful and eye-catching floor merchandiser that attractively displays a complete assortment of fluorescent lamps has been announced by Sylvania Electric Products, Inc.

Easily assembled in just a few seconds' time, rigid and durable in construction and taking up only a minimum of floor space, the merchandiser holds a standard stock of fluorescent lamps including 15, 20, 30, and 40 watt sizes.

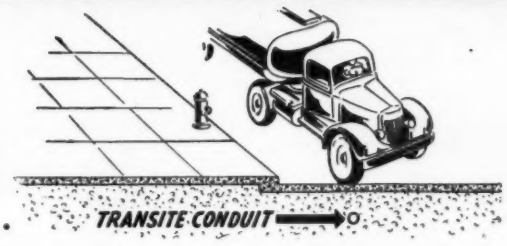
The display is beautifully lithographed in eight colors and includes two small lithographed counter cards for use in conjunction with the merchandiser.

Silv-A-King Luminaires

The Bright Light Reflector Company, Brooklyn, N. Y., has just issued a new booklet entitled "Silv-A-King Makes Light Work for You." The new book is not a catalog but a descriptive bulletin dealing with the practical application of fluorescent and incandescent lighting to industrial plants and the particular advantages of each for meeting a given plant's requirements. It lists eight important advantages claimed for Silv-A-King lighting equipment and presents numerous photographs of actual industrial installations. In addition, it includes detailed descriptions of both Silv-A-King fluorescent and Silv-A-King incandescent luminaires. Copies of the booklet are available upon request to the manufacturer.

WHY *TWO TYPES* OF *TRANSITE DUCTS?*

For Use Without a Protective Envelope . . .



Transite Conduit saves on labor and material, for it is so strong it needs no protective casing. It maintains its strength and true form under heavy earth loads and traffic pressure. Can't rot . . . effectively resists soil corrosion, smoke and fumes.

For Use With a Protective Casing . . .

Transite Korduct is thinner walled, lower priced, otherwise identical with Transite Conduit. Its long lengths mean fewer joints, fewer spacers. And its unusually high rate of heat dissipation lowers cable operating temperatures, boosts system capacity.

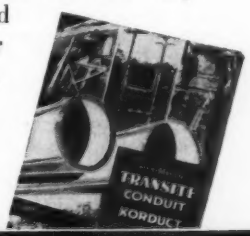
BOTH THESE DUCTS PROVIDE THESE ADVANTAGES AS WELL . . .

1. Minimize fire hazard—Transite Ducts cannot burn because they are made of asbestos and cement. They will not contribute to the formation of explosive or combustible gases.

2. Eliminate electrolysis problem—Inorganic and non-metallic, Transite Ducts can never be affected by electrolytic action.

3. Make cable pulls easy—The smooth bore of Transite Ducts speeds up cable installation. Because the ducts stay smooth in service, cables can be removed and replaced at any time with virtually no damage to sheathing.

4. Save time on installation—Light in weight, supplied in long lengths, Transite Ducts are so easy to assemble that only the minimum of time and expense is required for any job. Write for Data Book DS-410, Johns-Manville, 22 E. 40th St., New York, N. Y.



Johns-Manville

TRANSITE DUCTS

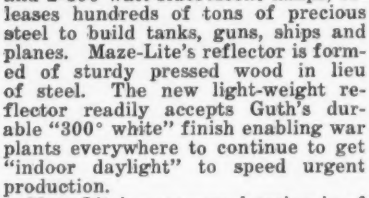
TRANSITE KORDUCT— for installation in concrete

TRANSITE CONDUIT— for exposed work and installation underground without a concrete encasement

Hardboard Reflector Unit

The new Maze-Lite for 2-40, 3-40, and 2-100 watt fluorescent lamps, releases hundreds of tons of precious steel to build tanks, guns, ships and planes. Maze-Lite's reflector is formed of sturdy pressed wood in lieu of steel. The new light-weight reflector readily accepts Guth's durable "300° white" finish enabling war plants everywhere to continue to get "indoor daylight" to speed urgent production.

Maze-Lite's accessory housing is of steel and features "Side-of-Channel" starter-switches for easy trouble-shooting, and "bumb-proof" end-



plates which extend behind the lamp-holders for added protection to these parts during transit, installation and servicing. For unit or continuous mounting, Maze-Lites can be attached to conduit or to chain-hanger. When jack-chain is used for hanging, it is attached direct to channel, no angles or extra parts being needed—further conserving steel.

Maze-Lites are now available for immediate shipments. For further details write Edwin F. Guth Co., St. Louis, Mo.

Flame-Proof Fixture

A flame-proof fluorescent lighting fixture of moulded asbestos, listed by the Underwriters' Laboratories, and substituted for steel lighting fixtures, the "Asbestolite," has been announced by Century Lighting, Inc., New York City. The new unit is designed for use in industrial plants where complete fire resistance is required.

Protective Lighting Brackets

Two new protective lighting brackets have been announced by Line Material Company, Milwaukee, Wis. These are both adjustable brackets designed for pole mounting of protective lighting luminaires where vertical and horizontal adjustments are required, particularly in the case of fence lighting with Fresnel lens type luminaire.

The pendant type bracket is available for inner or outer wiring. It will accommodate both the L-M Fresnel luminaire and the L-M Prismalite luminaire, two luminaires applicable to most every protective lighting requirement.

A Clamp-Around type bracket will accommodate the Fresnel and Prismalite luminaire used in combination with the L-M Clampolite wet process porcelain head. The porcelain is held in compression offering maximum mechanical strength and minimizes the danger of interruption of service should the porcelain head become broken.

The Line Material Company has recently issued a new bulletin on protective lighting, "Light Up to Protect War Production." This is a 12-page booklet describing the various conditions of protective lighting and explaining the proper luminaire to be used when planning an efficient lighting layout. Recommendations for mounting heights and spacing are shown together with illustrations and listing of standards, bracket, and mastarms. Copies of the new bulletin may be obtained by writing to Line Material Company, Milwaukee, Wisconsin.

High Bay Lighting Unit

A new unit for lighting high and medium high factory spaces, airplane hangars, etc., is announced by the Sterling Reflector Company, Chicago.

Known as Sterling No. 5526 this new unit consists of a Silvered Glass Reflector with the Sterling Lite-Flo Stipple in a metal housing with adjustable porcelain socket. The socket may be adjusted for efficient use with 750, 1000, and 1500-watt PS lamps, as well as for 400-watt mercury vapor lamps.

A unique feature is the housing design which provides air passage between the housing and the reflector, permitting circulation both inside and outside the reflecor, which keeps temperatures at a minimum.

Non-Metallic Fluorescent Unit

Non-Metallic industrial units by Lighting Products, Inc., of Highland Park, Illinois, are so designed that approximately only a few ounces of small steel parts are used in the construction of the housing and reflector which are of non-metallic material. Knockouts are provided in the housing at convenient intervals for easy wiring.

The ballasts and starters are mounted in the housing allowing the reflector to be removed easily for cleaning or servicing.

The reflecting surface is of Klasium white which is a tough bonded white enamel perfected by Lighting Products and which has been used over a period of five years. It does not discolor with use and provides an unusually high reflecting surface.

Other models are available with metal housing and non-metallic reflectors which may be used individually or in continuous runs.

Detachable Luminaire Support

The fixture support illustrated here is designed to permit the removal of the complete luminaire for cleaning and other maintenance work. It is a special type of hook and plug with the electrical plug so arranged in relation to the mechanical hook that the luminaire cannot be removed from the hook until the plug is completely removed from the receptacle.

These special hangers are available with two-wire plugs for incandescent or mercury units and with four-wire plugs for combination luminaires. Further information can be obtained from the Westinghouse Lighting Division, Edgewater Park, Cleveland, Ohio.

Telescopic Platform

Lewis-Shepard Sales Corporation, Watertown, Massachusetts, have released literature this month on their forty foot telescopic portable elevator for use on maintenance and construction work. It gives the user the advantages of standard Lewis-Shepard portable elevators, plus the effect of a rapidly moved staging, inside or out. It not only raises materials for installation or lowers them for removal; but it also gives generous platform footing as well.

Among some of the more general uses for this stacker are the installation of sprinklers, wiring, lighting fixtures, etc. Many other practical uses will suggest themselves to the maintenance superintendent.

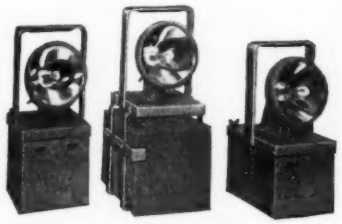
Adjustable Portable Light

Adjustable from thirty inches to seven feet and designed to project light into many inaccessible places is a new portable fluorescent service light recently developed for industrial uses by the Lumider Manufacturing Company of Los Angeles, California. The U. S. Army first ordered the light for servicing planes at night, but it has been widely adopted by industrial plants.

Upward or downward, horizontally or vertically, or in any angle of a 180 degree arc, the unit is adjustable without the use of tools. A well-balanced cast iron base makes the light practically impossible to upset.

Damage Control Light

The F. W. Wakefield Brass Company, Vermilion, Ohio, has announced several models of damage control light for emergency purposes. The damage control light is a high intensity source of emergency light intended primarily for use by damage control personnel on board ship. Its rugged, durable, and dependable construction lends itself for use by fire departments, power companies, industrial plants, telephone and telegraph companies, etc., for the lighting of emergency repairs. High light output is obtained by application of an over-voltage to a sealed-beam lamp normally rated at 6 volts.



Available in three different types, all three lights include a lamp head assembly which consists of a sheet steel lamp housing to which is riveted a polished channel designed to enable vertical positioning of the lamp. Unlike automobile sealed-beam headlights, this lamp has a clear face which transmits the light without diffusion.

The lights are equipped with a cover and attached bracket for holding. All lamp models are supplied in sprayed infra-red baked grey enamel. Safety red enamel can also be supplied on factory order.

Manual Reset Lamp Starter

A new manual-reset fluorescent lamp starter, called the "Master No Blink," which locks dead lamps out of the circuit, thus allowing instant dead lamp replacement, has been announced by General Electric's appliance and merchandise departments.

The "Master No Blink" starter with its manual-reset feature offers several advantages over the automatic starter. In automatic starters, a flow of current is required to keep the dead lamp from flickering. With the "Master No Blink," no current flows through the ballast after the dead lamp has been locked out. This current cut-off feature prolongs the life of the ballast. It also eliminates the "cooling" period which is required for replacement of lamps using automatic starters.

When the new "Master No Blink" locks a dead lamp out of the circuit, a small red button on top of the starter snaps forward. When the worn-out lamp is removed from the fixture, the red button is pushed in manually to reset the starter, without removing starter from the fixture. Lamps can be changed without shutting off the current.

At present, the "Master No Blink" starter is available only for 40-watt and 100-watt lamps.

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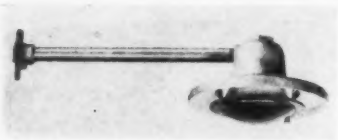
CRESCENT ENDURITE SUPER-AGING INSULATION

G-E Blackout Street Light

General Electric's blackout street luminaire—one of the first to be developed in this country—has been officially approved by the War Department, according to an announcement by the company. Redesigned to meet the revised specifications for American outdoor blackout lights, it provides a lighting intensity equivalent to 1/50 of the illumination of a full moon.



To eliminate likelihood of breakage from shrapnel or flying particles during an air raid, the G-E luminaire has been built without glass and employs only plastics and iron. Light is supplied by a 9-watt long-life lamp placed in a plastic band. The luminaires are equipped with brackets, and can be installed either on buildings or on wood poles.

Blackout street luminaires, spaced from 100 to 150 feet apart, are expected to be used mainly in areas where blackouts may hold up production for war or military movements. In such cases, they will be installed on streets leading directly to war production factories or other vital war areas. Because of the low-wattage, long-life lamp employed, the luminaire may be operated 24 hours a day at low cost and be always in service when the blackout alarm is sounded.

New Switch Saves Brass

In order that brass may be released for the production of shell casings, McGill Manufacturing Company, Inc., Valparaiso, Indiana, have redesigned their No. 41 Levolier Switch.

The new switch, known as No. 41-B, made with a pastic casing, steel lever, nut and chain, is compact,

light in weight and sturdy. The elimination of the cap used on the brass switch facilitates the affixing of the fires and assembly of switch. A simple flat spring catch, when pressed, releases the switch mechanism from the plastic shell for wiring. Reassembly is accomplished without tools by pressing the mechanism back into the shell until the spring catch snaps into place.

Turn to page 87 for further news about "New Electrical Products and Materials."

Industrial Fluorescent Units

Designated as "Priority Industrial Fluorescent Luminaires," a new line of fluorescent units has been announced by the Keystone Electric Mfg. Company, Philadelphia, Pa. These units are designed for general and localized illumination in war production plants and are available to prime contractors and sub-contractors having priority ratings.

A new four-page bulletin is available describing these units. Among the construction features claimed for them are: 13° to 14° shielding angle design; all parts mounted in chassis with reflector carrying its own weight only and being easily removed for cleaning by simply removing two wing nuts; starters located behind lampholders thus permitting replacement without disturbing lamps; units arranged for rigid conduit, flexible conduit, or chain mounting; adaptable for continuous row mounting; units equipped with non-stroboscopic two-lamp ballast with power factor above 90 per cent; and provision for installation of a third lamp at a later date.

Automatic Electrical Timer

A simple, foolproof electrical timing device which should find many applications in industrial plants has recently been announced by Philco Corporation, Philadelphia, Pa. This automatic time switch is arranged to close an electrical circuit after the expiration of a pre-determined time, although it can be adapted for opening a circuit by simply reversing the position of the mercury switch element. When used on a-c circuits, it has a capacity of 1200 watts, sufficient to control a 1 hp motor of the repulsion induction type.

The setting operation merely requires the turning of a knob to the time (AM or PM — up to 23 hours in advance) that the switch is to operate.

Fasnacht Floodlight

A new floodlight designed for lamps on 300 to 1500 watts has been announced by Ira E. Fasnacht, Ephrata, Pa. The new unit designated as No. 112 is 19" wide, 20" high and 16" deep. It is constructed of heavy gauge metal with wire rolled in edge, painted blue, green or aluminum outside with special heat resisting white or aluminum inside.

The reflector is made of cast aluminum, painted aluminum or white inside and is so constructed that various lamp sizes are always in the proper focal position. The contour is part parabolic and part spherical. The brackets provided allow universal adjustment and with suitable fitttings will mount on any flat surface or clamp on any standard pipe from 1½ inches to 13½ inches in diameter. Further information may be obtained from the manufacturer.

Dimout Street Light Shield

Dimout protection for street lights located in coastal areas is provided by a new cone-shaped shield which has just been developed in General Electric's illuminating laboratory. It is carefully designed to eliminate both

direct and sky glow which silhouettes cargo ships off shore and makes them targets for enemy submarines.

Made of noncritical weatherproofed material, the cone is shaped to fit all series sockets.

Portable Floodlights

Steber Uti-lites are made especially for industrial plants, to facilitate maintenance and repair work. The Floor Type on casters provides a strong portable auxiliary unit with adjustable bracket arm which may be moved to any position within the spherical radius without the need for loosening or tightening up of any nuts or clamps. The reflector is not secured to the socket, which has the effect of loosening the assembly, but is carried over the socket and secured to the bracket arm itself. This same type of Uti-lite is furnished with an arm for permanent mounting to machinery, bench, wall or post.

Another type of Mobile all-purpose floodlight used for maintenance work is the small Circulite which has casters for easy movement on the floor and also can be hung up from any convenient hook to throw extra light as may be required by maintenance crews in industrial plants, shipyards, and garages. Both the above are from the equipment lighting line made by the Steber Manufacturing Company, Chicago, Illinois.

A Natural for War-plant Lighting

THE NEW G-E 4-LAMP BALLAST

Operates four 100-watt fluorescent lamps, yet costs no more than a Tulamp 100-watt ballast.

Reduces copper requirements of plant lighting circuits. Operates over a line-voltage range of 250-280 volts; applicable to circuits in the 265/460-volt-Y class.

Cuts ballast electrical losses 46 per cent for a given installation —an appreciable power saving.

Saves nearly 50 per cent in ballast materials for a given number of lamps.

THE new G-E four-lamp ballast—made possible by General Electric's revolutionary sequence-starting circuit—opens the way to simplified fluorescent fixtures that cost less, weigh less, and use much smaller amounts of critical materials: copper, iron and steel, and aluminum.

Compared with two 100-watt Tulamp ballasts—the most economical type previously available—the new four-lamp ballast requires 48 per cent less copper, 47 per cent less iron and steel, and 50 per cent less aluminum.

Savings in Copper for Plant Circuits, Too

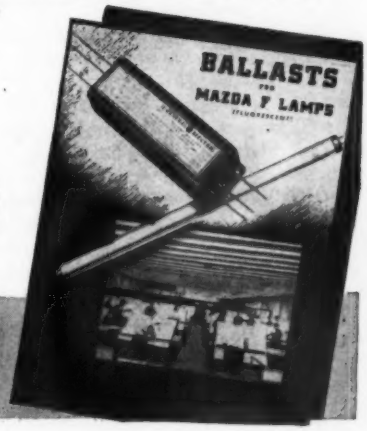
Circuits carrying power at the higher voltages (between 250 and 280 volts) necessary for the operation of the new ballast require much less copper than circuits carrying the same amount of power at lower voltages. For example, on a single-phase circuit only one-fourth to one-third as much copper is required to carry power at 265 volts as would be required to carry it at 115 volts. Many new war plants—particularly those with load-center distribution systems—will have Y-connected circuits of 254/440, 265/460, or 277/480 volts, to all of which the four-lamp ballast can be connected line-to-neutral. Other plants converting for war production can often provide one of these voltages on their lighting circuits.

The four-lamp ballast has the same mounting dimensions as the G-E Tulamp ballast.

Power factor of the four-lamp ballast, like that of the Tulamp ballast, is above 95 per cent.

Write today for complete information on this remarkable new ballast. Ask for Bulletin GEA-3293D. It contains information on the complete line of G-E ballasts for all MAZDA F lamps from 4 to 100 watts. *General Electric Company, Schenectady, N. Y.*

The Navy "E", for Excellence, has been awarded to 92,780 General Electric employees in five plants manufacturing naval equipment



GENERAL ELECTRIC

Universal Type Trol-E-Duct

The Bulldog Electric Products Co., Detroit, Mich., has just issued an attractive bulletin, No. 425, describing the "700" line of Bulldog Universal type Trol-E-Duct.

The bulletin includes photographs of outstanding Trol-E-Duct installations as well as complete details on the components of the "700" line and their combinations to form pre-fabricated busway wiring methods having a high degree of flexibility. The latter part of the bulletin contains much helpful information on the design of Bulldog Trol-E-Duct installations.

Personal Notes About Men You Know

(*Continued from page 64*)

In 1930 he left the company to accept a position with the Dallas Power & Light Company in their designing division. In 1931, he returned to Southwestern Gas and Electric Company in various capacities in the oil field, and in 1938 he was made division engineer for the East Texas oil field district. In 1939 he was transferred to Texarkana as assistant to the late Andrew Patterson, who at that time was chief engineer of the company. He went to Shreveport in 1940 when the general office engineering department was moved there.

Keeping Your "Working Capital" Working

(*Continued from page 54*)

ply of working capital gives the credit-seeker a preferred rating with suppliers and his bank because it indicates that a prospective debtor is not too heavily mired in fixed assets, that he has not suffered operating losses, two factors that drain working capital. After the duration, credit will loosen up and, sooner or later, the small business man must be put in a position to get business loans. No doubt, those who have weathered the war period with adequate working capital will be given preference.

The absence of reserves on a balance sheet wakens the ratio of fixed assets to current assets, which is another yardstick used by bankers to determine safe risks. Mitchell had set up no reserves and had he done so, he would have reduced his fixed assets and improved the ratio of current assets to fixed assets, which at, one to one approximately, is not satisfactory but should be at least 1½ of current assets to 1 of fixed assets.

With taxes skyrocketing, the contractor should charge the profit and loss account with a reasonable estimate of taxes monthly. To wait until the tax is due for the year and then charge it en toto at one time is a dangerous breach of cost control today because the taxes, in this way, are never figured in current costs when setting selling prices for services, merchandise or installations with priority ratings. From the bookkeeping standpoint, these tax allowances are charged to profit and loss monthly and credited to a reserve for taxes.

Of course, ratios like all other accounting data, should be used as an aid to the formation of judgments, not as a substitute for judgment. The contractor must judge in the light of all relevant circumstances whether the working capital ratio disclosed by the financial statement is satisfactory from the standpoint of financial safety during this crisis and the economical use of working capital.

He should consider this ratio when appraising the other elements of his business, a thing too seldom done in this field with unprofitable, sometimes disastrous results in normal times, and certain, at a time like this, to cripple the contractor's ability to keep his business safe until the boys come marching home and reach the postwar period in a sound financial condition.

Taking Guesswork Out Of Appliance Service

(*Continued from page 50*)

As opportunity presents itself, they inspect these odds and ends, salvage whatever they think may prove usable later, and dispose of the remainder as scrap metal.

During their first three months in business, the partners replaced approximately 1,500 domestic and commercial range heating-elements. Most of these they can repair at their leisure with a patented mending device, thus building up a backlog of replacements on range-models which have become obsolete. Heating elements for these ranges are becoming increasingly hard to obtain.

Capitalizing on night traffic — automotive and pedestrian — Madden and Meyer keep their shop open on week days until 10 P. M. or later. Evening "drop ins" add still further to their growing volume. Many small-appliance owners, who ride the busses to business, take advantage of the "after hours" opportunity to bring in electric toasters, fans or lamps which need repair. Theatre-goers frequently leave a waffle baker or a pressing iron to be re-conditioned and called for on the way home.

Since the serving of "drop in" customers uses up none of the firm's rationed tires or gasoline, Florida Appliance Service encourages this class of trade by giving "cash and carry" patrons a special price of $1.50 per hour.

For commercial calls the firm charges at the rate of $2.30 per hour, because this type of service nearly always involves a special trip. The hourly rate for domestic service is $1.75. As a rule, such calls can be grouped so that several of them in the same section of the city may be made on one trip.

Under present conditions the partners feel that they cannot afford to invest precious time, fuel and rubber in making free estimates on repairs. The firm makes estimates at an agreed flat price of $1.50. This amount, of course, is deducted from the invoice, if work is ordered. Practically all requests for advance figures on repairs come from commercial customers, hotels and apartment houses.

Preferring to publicize their business in other ways, Madden and Meyer do very little newspaper or radio advertising. One of their pet methods of fixing themselves and their work in customers' minds is the employment of a small gummed sticker to identify any repair they make, when answering residential calls. This sticker, which is only 1¼" x 2", bears the firm name and telephone number. Attached to range utility-drawers or fuse boxes, these labels remind patrons whom to call when appliance service is needed.

Freeze Order Has Its Silver Lining

(*Continued from page 52*)

pairs are usually made on the premises.

"Electric irons are most frequently brought to us for service," said Mr. Boggs. "That is probably because they are used longer hours in the home than any other electrical equipment. Ofttimes, also, they are mistreated, especially by servants. Next comes the

for 600-Family Federal Housing Project at Bridgeport, Connecticut

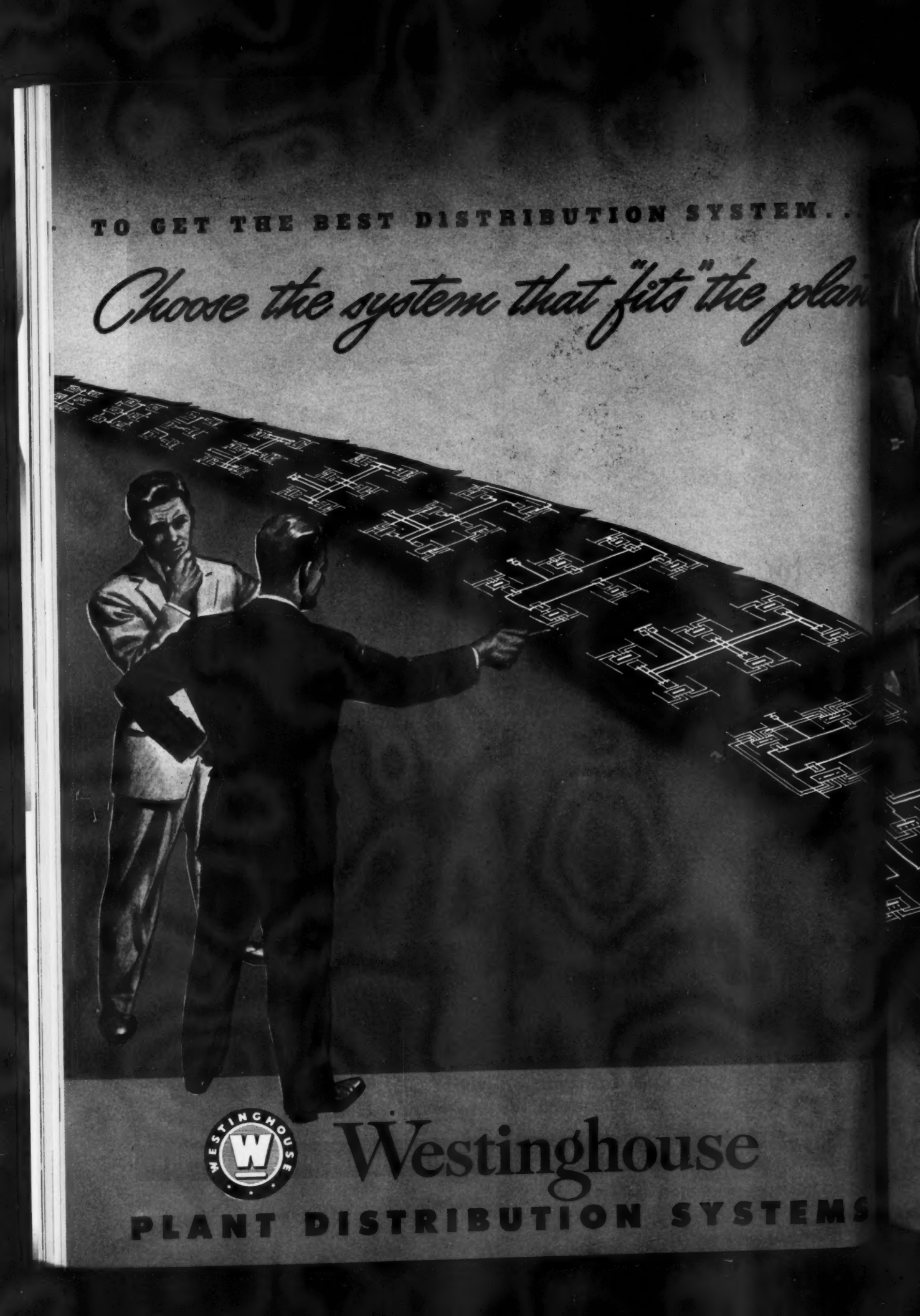
At left is shown the flush type Colt Multi-Breaker installed in all apartments . . . below, the outdoor installation of Colt Meter Socket Troughs and a Colt Multi-Breaker in raintight enclosure.

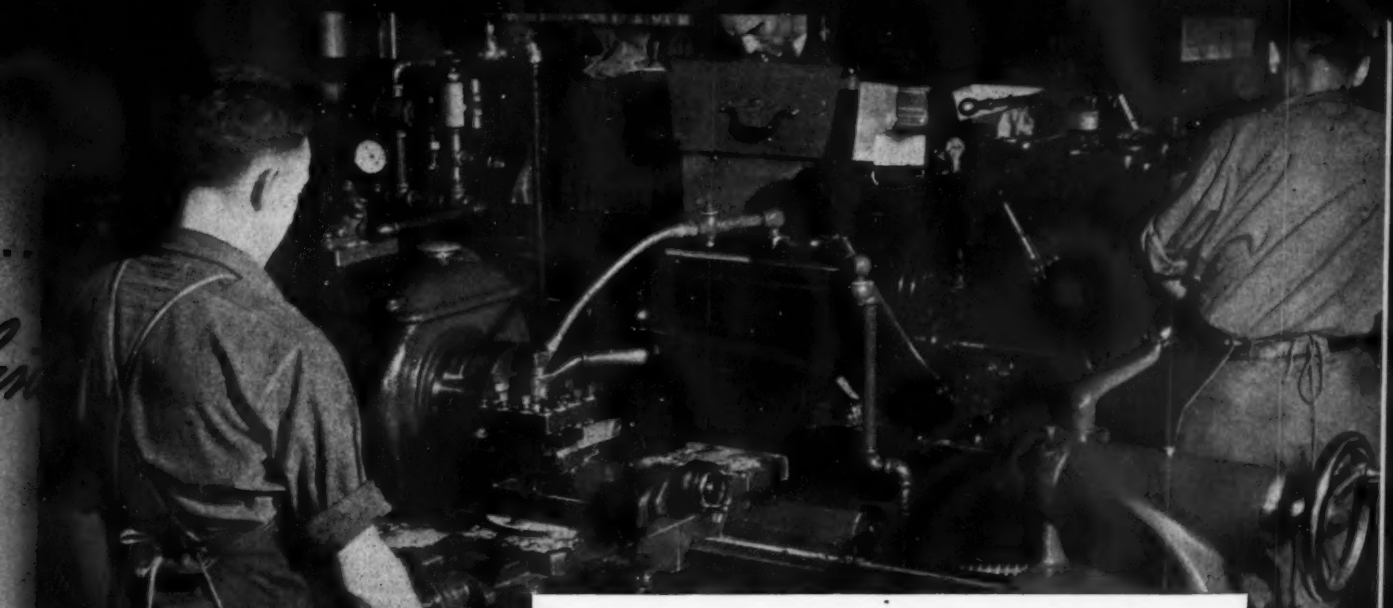
Another Federal Housing Project — 150 buildings — 600 apartments — completely equipped with Colt Multi-Breakers and Colt Meter Socket Troughs.

All buildings are arranged for outdoor metering with 4-meter troughing units . . . in addition, on thirty-one buildings is mounted a Colt Multi-Breaker with an extra socket for clock switch to control the street lighting. In each of the 600 apartments, a Colt Multi-Breaker has been installed for distribution, circuit protection and control.

Write for Complete Information about COLT MULTI-BREAKERS . . . the Modern Way to Wire a House!

COLT'S PATENT FIRE ARMS MFG. CO. - Electrical Division - HARTFORD, CONN.


TO GET THE BEST DISTRIBUTION SYSTEM . .
Choose the system that "fits" the plan
Westinghouse
PLANT DISTRIBUTION SYSTEMS



THERE is no one universal plant distribution system. Plants vary too greatly. The power distribution system that served ideally in one plant may be entirely wrong for another one.

To get the best results, both from the standpoint of economy and efficiency, be sure the distribution system you select "fits" the plant. Regardless of size, shape, or type of factory, you will find it easy to select the system that will give you the best results.

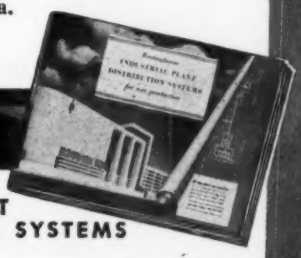
Westinghouse can supply equipment for all types of power distribution systems, including the new Plant Network System now installed in approximately 40 large war factories.

All systems recommended by Westinghouse are designed for use with standard distribution equipment. There will be no time lost in building special apparatus.

To help you save time in selecting the distribution system that best fits your requirements, Westinghouse has prepared a special book that briefly describes a group of different plant distribution systems. Just fill in and mail the coupon for your copy.

If you want faster action, call our local office. One of our engineers will be glad to discuss your distribution problem with you.

Westinghouse Electric & Manufacturing Co.
East Pittsburgh, Pa.



FREE QUICK FACTS ABOUT PLANT DISTRIBUTION SYSTEMS

Westinghouse Electric & Mfg. Co.,
East Pittsburgh, Pa.

Please send book B-3152 giving quick facts on Westinghouse Distribution Systems.

*Name*_____ *Title*_____

*Company*_____

*Address*_____

*City*_____ *State*_____ J-94511

percolator. In season, we have a lot of electric fan business. We have always specialized in radio repairs and in addition a wide assortment of appliances of practically every kind pass through our shop.

"Formerly, a customer was guided in the repair of an appliance by the cost compared with that of a new one to replace it. As new merchandise is difficult or impossible to obtain, a new standard has to be applied, and that is 'Can the customer do without the appliance?' We find we cannot have a fixed rate of charges as every job is different, but do think many shops make a mistake in not charging enough, probably counting their labor and parts only and not figuring overhead. The repair business is complicated by the fact there are numerous cheap appliances in use today. A customer naturally doesn't want to pay much for the repair of an electric iron which cost only $2.00 new, although the use value is taking more and more precedence today. However, we find our customers willing to pay a reasonable service charge, provided the appliance gives satisfactory performance.

Mr. Boggs has not been affected much, as yet, by the scarcity of good repairmen. However, his daughter, Mrs. Helen Barnes, who is office manager, has learned to repair small appliances, and says she can "fix an iron as good as anybody," yet she admits being baffled a bit by thermostats and by the glass wool insulation in electric cookers. Whether the shop will have to use girls generally in the repair service remains to be seen, Mr. Boggs said.

According to Mrs. Barnes, nearly every woman customer who brings in an appliance for repair is an amateur repair expert herself as she 'knows exactly what is wrong' with the appliance. As a matter of fact, Mrs. Barnes added, the customer was usually wrong, but of course isn't told so in so many words.

The Boggs company buys, reconditions and resells used appliances and this helps to keep the shop busy. In addition, the company offers a complete electrical contracting business, including wiring and hanging of fixtures. This end of the business is now restricted to repairs since new building is practically out for the duration.

There is one big advantage of a repair service over the sale of new equipment, as pointed out by Mr. Boggs. It is nearly all done on a cash basis!

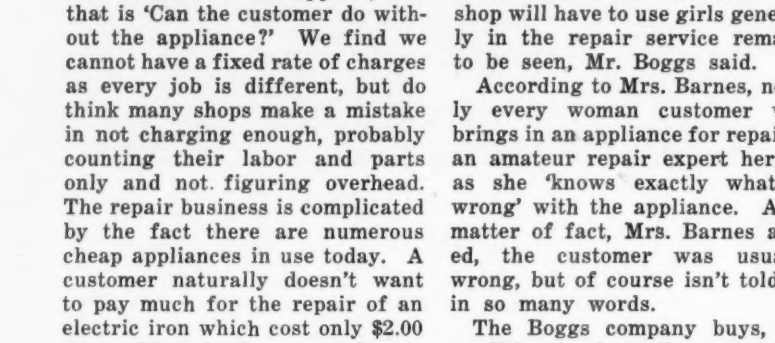
Research Saves Strategic Metals

(*Continued from page 46*)

companies, transformer and generator manufacturers, shows that the amount of steel used in boilers, generators, condensers, substation equipment, power and distribution transformers, transmission and distribution lines, and in structures, amounts to 431 lbs. for each installed kilowatt, and that the total copper per kilowatt is 120 lbs. Therefore, the accompanying tabulation can be set up for the typical 50-footcandle installation outlined above.

Since this comparison is made on the basis of equal illumination, the same ratio will hold true regardless of the footcandle level to be considered, that is, 66% more steel and 130% more copper required for an incandescent system producing footcandle levels equal to a fluorescent system. It is probable that with a little more careful analysis when wire sizes are determined for new installations, considerable copper may be saved by reducing possible increase tolerances. It has always been good engineering to allow for future expansion and increases in lighting level demand by providing anywhere from 10% to 25% or even more extra capacity in wire sizes. It still is good engineering, but with today's use of essential copper for war materials, it may be better engineering to weigh more carefully the probable future increase, and provide only that extra wire capacity which is almost certain to be required.

As is well known, the trend in fluorescent lamps has been one of increased efficiency, longer life, and lower cost. This trend is the result of improvements in manufacturing technique and changes in construction design. One of the most important developments during the past year involves a method of placing the necessary amount of mercury in



And there's just as much difference between the *streamlined* BRIEGEL METHOD of making conduit connections and former, old-fashioned methods!

Take a look at the picture below: two squeezes with the patented B-M "indenter" (which costs only $1.25) and you have a smooth, efficient job when you use B-M connectors and couplings. No extra turns or twists—no nuts to tighten!

The BRIEGEL METHOD saves you up to 50% on time and a substantial materials-saving (in keeping with today's thinking). Means more profit, too! Approved by Underwriters' Laboratory, of course.

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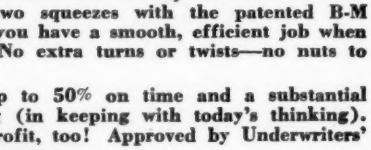

The M. B. Austin Co. Chicago, Ill.
Clayton Mark & Co. Evanston, Ill.
Clifton Conduit Co. Jersey City, N. J.
General Electric Co. Bridgeport, Conn.
The Steelduct Co. Youngstown, Ohio
Enameled Metals Pittsburgh, Pa.
National Enameling & Mfg. Co. Pittsburgh, Pa.
Triangle Conduit & Cable Co. Elmhurst, N. Y. C.

BRIEGEL METHOD TOOL CO., Galva, Ill.

fluorescent lamps without excessive waste, and is generally referred to as the "mercury bomb." (Fig. 2.) This method was adopted by one manufacturer several months ago to save mercury as well as improve quality, and the actual saving since its adoption runs into hundreds of pounds of mercury.

At the same time the "bomb" was placed in use, the pure nickel anodes or cathode "probes" were eliminated from the cathode construction of 40-watt lamps. Other sizes have continued to use a "probe" of nickel plated iron, but within a short time these too will be eliminated, with a consequent saving of nickel also amounting to hundreds of pounds.

By changing from lead glass to lime glass in the manufacture of fluorescent lamps, hundreds of tons of lead will be released to make bullets. Although lime glass is somewhat less expensive to buy, it is a much harder glass, requiring a different method of handling in lamp manufacture. Lime glass is about 15% lighter than lead glass, since the amount of lead exide in the glass (about 25%) is replaced with essentially the same amount of lighter lime. Incandescent lamps have been made of lime glass for some time, with the exception of a very small number of special lamps.

It has been pointed out how tin is saved by changing the composition of solder used in incandescent lamps. At present, one manufacturer of fluorescent lamps (as well as incandescent) hopes to go one better and eliminate all solder on fluorescent lamp pins. This method would be described as a "crimped pin," which merely means that the hollow steel tube pin through which the lead wire passes is "crimped" in to secure the wire and make a solid electrical contact, thus making the use of solder unnecessary. There are several problems to be overcome, however, before this change can be released for general use. (Fig. 3.)

The various fluorescent coatings are made up of metallic compounds containing such elements as zinc, magnesium, tungsten, cadmium, barium, beryllium and others. Continuous experimentation in lamp company laboratories has accomplished ways of reducing the metallic content of some of these fluorescent powders in varying degrees from two to twelve per cent.

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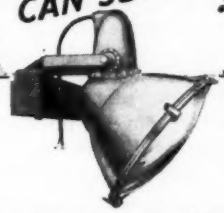

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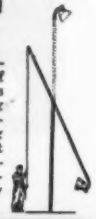

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As would be expected, the largest savings of critical matedials are found in developments relative to fluorescent fixtures and their auxiliary equipment. One of the first changes brought about as a result of the war was the replacement of aluminum cans covering fluorescent lamp starters, with cans of a less essential metal.

The new four-lamp ballast used for the so-called "sequence starting" circuit is expected to save many tons of copper, iron and aluminum during the next year. This auxiliary is employed primarily in large war industry plants where 254 and higher voltage circuits are used. It operates four 100-watt fluorescent lamps, whereas the standard ballast only operates two, and it is particularly applicable where continuous row illumination is to be provided.

The Non-Metallic Reflector

Probably the greatest saving of critical material has been brought about through the development of a non-metallic fluorescent reflector. A conservative estimate of the potential saving of steel through the production of this reflector is 2,000 tons per month (Fig. 4). Several models were undergoing experiment and tests in the laboratories of one lamp and equipment manufacturer for eight months prior to its announcement by that company in May of this year.

In general appearance, contour, and performance, it is equal to porcelain enamelled steel, although perhaps not quite as rugged physically. The reflecting surface is a hard white enamel, baked on with infra-red radiation. (Fig. 5.)

In May, the War Production Board issued an announcement to the effect that open-end steel reflectors only should be manufactured by the fixture companies. Of course all manufacturers complied, with a consequent substantial steel saving.

Metal Saved in Small Parts

There are a great many smaller items which in the aggregate will result in the release of sizeable amounts of various metals. Contact screws in fluorescent sockets, for instance, have previously been brass, but shortly will be of plated steel. Hereafter, one company will use screws in its fixture assembly which have been "Parkerized," or undergone a rust resisting treatment instead of metal plated screws. The socket contact clips will be steel instead of brass. Aluminum paint finishes will give way to white enamel. Pull switches installed in the fixtures will have Bakelite cases instead of brass. Instead of solid brass eyelets on the ends of lead wires, plated steel will be used.

Not all changes result in metal savings. Instead of rubber covered cords in portable equipment or industrial fixtures, the wires will be protected by a heavy duty braided fabric designed to take as much punishment as rubber without danger of exposing bare wires.

None of these substitutions are made easily. All require research, testing, changes in manufacturing processes, and countless manhours of engineering and laboratory work in order that high quality and performance standards may be maintained. The lighting industry is well aware and proud of its important part in the Victory Program—to provide the best possible illumination for thousands of war plants operating 24 hours a day, 7 days a week, so that planes, ships, and guns will reach the world battlefronts—and fast.

There Won't Always Be a War!

(*Continued from page 41*)

Other lamps already rather widely used will find new and varied applications because of the experience gained in their war service. Drying lamps are speeding many war industry processes today that would be retarded if old methods of drying still had to be used. Here is a brand new field that holds many interesting applications. Where formerly the illuminating engineer confined his interest largely to the visible portion of the spectrum, today he must become familiar with the infra-red, which is the field of the drying lamp, and ultra-violet portions as well. Accelerated research and development due to the war will reveal new values and uses of radiation in these realms.

The therapeutic value of infra-red has long been known. Greatly increased hospital work will no doubt bring greater experience with infra-red. So, too, will the ultra-violet end of the spectrum become better known as a means of sterilization and other important applications on the part of the medical profession. While doctors will do the prescribing, the development and installation will still be the responsibility of the lighting industry.

As time goes on, we will realize that fluorescent and phosphorescent materials can be widely employed in the war effort. Vast improvement in the quality of these materials as well as lower costs encourage their greater use for markers, signs, etc., for blackouts and dimouts. After the war is won, these materials have unlimited opportunities in decorative and advertising fields.

Speaking of decoration and advertising brings color to mind. Already in wartime studies we have learned things about color that we didn't know before. In peace-time various colored lights for signalling have been commonplace but the use of colored light for decoration and advertising has been rather limited. We haven't scratched the surface as yet. We're learning about the visibility of

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various colors; the effect of certain colors on the eye. The cost of colored light production is now much lower. Installations using colored light can be designed with engineering accuracy thereby assuring the production of any colored light desired. Instead of a "black and white" world after sunset, artistic colored lighting can bring new life and breath-taking beauty to many lighting fields.

Lighting has always played an important part in the life of all human beings. Today in the industrial war plants and on the fighting fronts, on the land and sea and in the air, light has a great responsibility. On the home front, too, light is playing its part in winning the war. With the new knowledge gained during the war, the new light sources, new materials, and new viewpoints, everyone in the lighting industry will have a responsibility to apply these things to peace-time requirements.

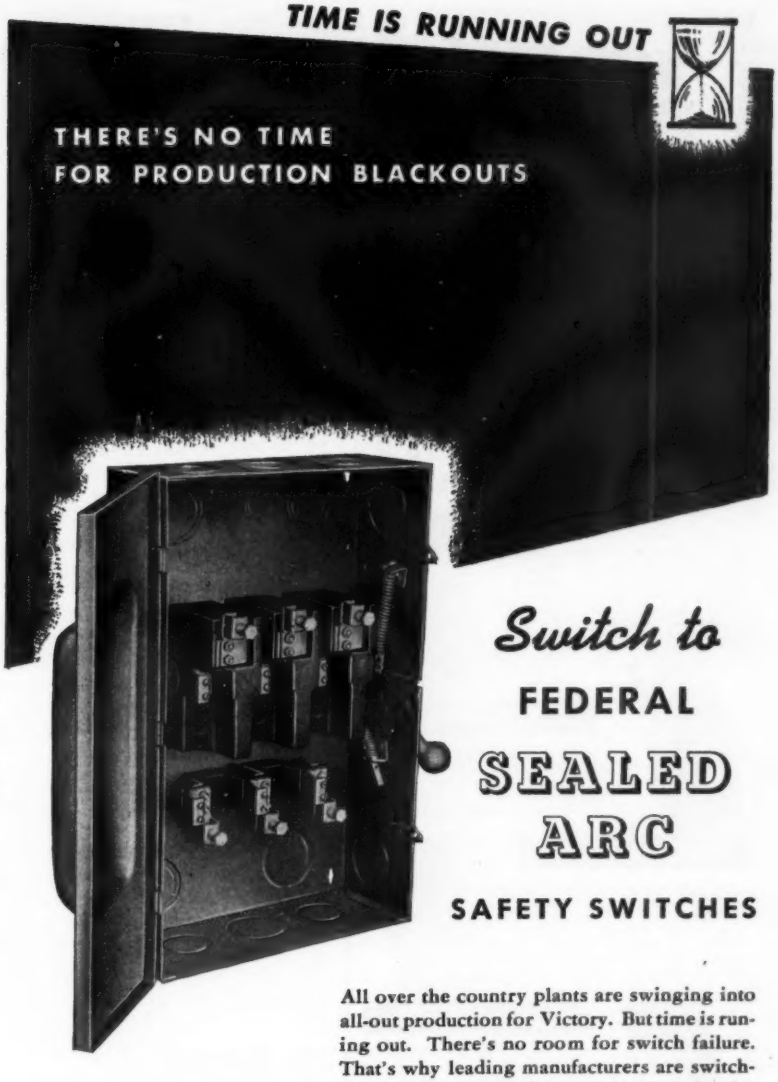
We know that we have a long hard struggle before us, one that will require our every effort and sacrifice. But even when the situation is at its worst, men in the lighting industry will be buoyed by the thought that there won't always be a war! And that just as light is doing its part in winning the war, so will it do its part in the reconstruction to follow, utilizing to the fullest extent the developments and improvements that have come out of the war.

Living Behind the Blackout Curtains

(Continued from page 39)

late the air. If no ventilation scheme is used, the lights may be turned out in the shelter room and the doors opened for a while.

Today our homes are more "lived-in" than for many years past. Gasoline and tire shortages are keeping Americans at home. Men and women carry on Red Cross work and First Aid studies at home; women are sewing and knitting; boys and girls are completing school work in less time which means more home work; and dozens of tasks too numerous for yesterday's eight-hour day are now home tasks. Normal life must go on in our homes. Our children must grow up in bright, cheerful surroundings which means that good, adequate light must be pro-



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vided even behind blackout curtains.

After the blackout plan for the shelter room has been perfected, careful attention should be directed to lighting arrangments. This is particularly true if the shelter room is one not normally used for living room purposes. It may be necessary to move portable floor lamps and table lamps to the shelter room to provide safe seeing conditions. Pin-to-wall lamps are admirably suited for meeting such flexible lighting requirements. Ceiling light fixture adapter equipment also provides an inexpensive and satisfactory means of providing adequate lighting.

This matter of normal living behind the blackout is not limited to the home but applies as well to commercial establishments such as apartment houses, hotels, and restaurants. One large and well known hotel in the South has made absolutely no blackout preparations and the confusion which resulted during a recent practice blackout was a ridiculous and disgraceful reflection on this hotel's management.

Utilities, electrical dealers, contractors, and distributors have a responsibility in seeing that the public has proper information concerning blackout and adequate lighting to carry on behind it. Manufacturers have prepared much helpful material in the form of booklets, educational moving pictures, and slide presentations.

An Appraisal of the Luminescent Materials

(Continued from page 37)

filament lamps but if the latter are given longer time they likewise will "pump up" the phosphorescent materials to a fair brightness.

The user of phosphorescent devices should note carefully that there are generally two classes of these materials. One, characterized by zinc sulphide and usually of a yellowish tint, will be somewhat brighter during the first few minutes of darkness but will fade with fair rapidity so that it is not likely to be easily visible after an hour or two of decay in the dark.

The second group usually of a bluish green tint and typified by strontium sulphide may not be quite as bright initially but should have a slower decay rate and should be quite readily visible to the dark-accustomed observer even after six or eight hours of darkness.

Because the phosphorescent materials have improved very remarkably since they were tentatively introduced a relatively short time ago, because there are many kinds and qualities, because their performance is influenced by the background surface and by solvents or vehicles, and because unprotected coatings or treatments are subject to rapid deterioration in combinations of moisture and daylight, the user must be critical in his selection for a special usage. Careless application by novices has given many of these products an unmerited bad reputation. On the other hand one must appreciate that phosphorescent objects are not substitutes for other illuminants and that the justifiable uses are strictly limited.

Phosphorescent surfaces provide their own automatic safety valve or governor because all of the known materials are definitely limited as to maximum brightness. For safe uses during a blackout, this can be a virtue. This brightness is on the order of .03 to .05

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footlamberts (brightness of the tube of a commercial Mazda F lamp is on the order of 1500 footlamberts). The phosphorescent surface, when brightly illuminated, becomes saturated and a prolongation of exposure will not cause it to increase in brightness, nor will a prolonged excitation period influence the general decay characteristics.

However, it must be noted that the brightness at saturation and during the first few minutes of decay can be increased through the use of an incident radiation particularly rich in the medium and short wave ultraviolet.

For example, the same material exposed to the Type A-H4, 100-watt mercury lamp may have a brightness of .05 footlamberts after one minute of darkness but in a second case might have about .03 footlamberts if it were excited by the same incident footcandles of tungsten filament illumination. After some 30 minutes of darkness or when the decay curves had come fairly close together, there would be no essential difference of brightness or visibility from that time on, regardless of the exciting source.

In practical usage, the phosphorescent object would probably be exposed to normal lighting for long periods of time and thus would continue in a state of saturation. Exposed to say 20 footcandles of incident light, it may require some four or five minutes of Mazda incandescent filament lighting to reach maximum saturation or brightness. This same saturation point would probably be reached in two minutes if the illumination were from a white Mazda F (fluorescent) lamp. If the daylight or the blue Mazda F lamp or the high intensity mercury lamp were used with this same 20 footcandles irradiation, the maximum brightness would probably be reached in something on the order of one minute.

When the exciting source is exceptionally bright and rich in short-wave lengths of visible light, such as the flash produced by a commercial photoflash bulb, most phosphorescent materials will be quite well pumped up almost instantaneously. Likewise a few seconds exposure to a large photoflood lamp will quite well excite these materials.

In general, however, we may say that during the first few minutes after excitation the commer-

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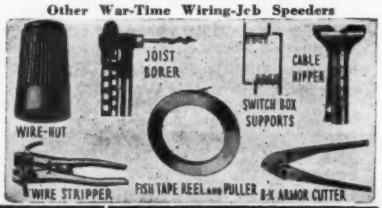

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cial phosphorescent surfaces appear about as bright as does an inert diffusing white surface when viewed under good moonlight. After approximately 30 minutes of decay, the apparent brightness of the phosphorescent surface will, in general, be about 10% of the initial brightness and from then on the apparent brightness holds fairly constant over a period of several hours. Fairly large areas of phosphorescent material, such as a surface one foot square viewed at arm's length, can be seen by the dark adapted eye in complete darkness after a decay period of 60 to 72 hours, but only just seen.

In appraising phosphorescent applications, it may be well to note that over the ordinary range of room temperatures there is not a noticeable difference of performance, but an unusual amount of infra-red radiation in the exciting source will adversely affect brightness or if the phosphorescent material itself is at some temperature much above 100° F. there will be a noticeable increase in initial brightness and a more rapid rate of decay. Conversely at temperatures somewhat below freezing, the performance of the phosphorescent material appears to become lethargic and the decay is prolonged at diminished brightness.

Normal usage suggests that phosphorescent applications be generally confined to signs, markers, instrument dials, and the like. If the entire ceiling of a normal room were of phosphorescent material, there would be sufficient emitted lumens after say one hour of decay to permit safe movements around the room. But interior phosphorescent areas are not in any sense substitutes for other illuminants and will not permit comfortable reading of print nor the viewing of detail.

Thus the first logical field that suggests itself would be such applications as wall switch plates, door knobs or panels, edges of moveable furniture, portions of stairs and railings, handles of tools or instruments that may have to be located in the dark. Phosphorescent house numbers are not usually of sufficient brightness a few hours after daylight exposure to be visible at a sufficient range. A 6-inch solid black figure or letter viewed against a phosphorescent background as in the case of a danger sign or locater, or in a window exhibit, would be easily legible across the sidewalk or at a distance of some 50 feet or less. For smaller characters or longer ranges, it might generally be necessary to re-excite the phosphorescent material at periods say of 30-minute intervals.

Where there is very little exciting radiation available, or where a constant level of brightness of markers on the order of the brightness of moonlight on white paint is desirable, then the radio-activated phosphorescent buttons or insignia can be advantageously used. In fact the trace of radium salts, as in zinc sulphide, affords a permanent luminescent target of exceptional value particularly in military services. The sustained brightness is on the order of .02 footlamberts, and if extraneously excited this figure may be doubled.

Any of these phosphorescent targets, while they may appear noticeably different in color immediately after excitation, soon all blend into an appearance of ghostly grayish white, chiefly because the dark adaptation of the

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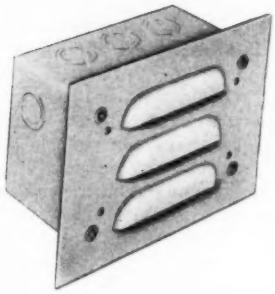

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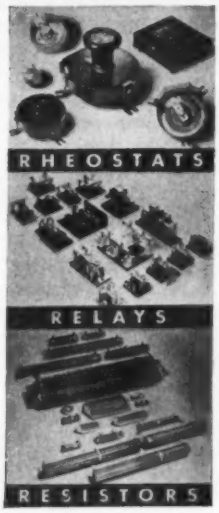

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observer shifts to rod vision wherewith we discern brightness and rough shape but not color.

The fixture manufacturer may well consider phosphorescent portions of fixture parts so that in case of sudden blackout certain rows of luminaires would indicate aisle positions or exits. Phosphorescent fabrics such as coat 'inings or traffic officers uniforms are logical. When a little further perfection is obtained of protective coatings such as sheets or tubes of vinyl resins or non-acid lacquers or where the incorporation of phosphorescent powders in hard surface non-porous plastics may become more common, then one great field of usefulness will be street and highway markers and close range outdoor signs.

The larger objects in a display case or show window, the purely decorative designs of interior wall paper, or the air warden's phosphorescent arm band, the rear portion of a parked automobile or the instrument dials, first aid cabinets and fire extinguishers and all manner of low brightness close range safety delineations — all these suggest how rapidly the phosphorescent materials are graduating from the curiosity of the laboratory or the mysteries of a vaudeville act to the routine jobs of aiding man's night-time vision.

Planning for Industrial Lighting Maintenance

(Continued from page 35)

of switches is to avoid over-loading. Any switch that is compelled to interrupt current greater than its rating may fail in a short time.

Whenever circuit loading is increased by adding luminaires or by increasing lamp wattage, the electrician should make it his responsibility to check the switches to insure adequate capacity. Often circuit breakers are over-loaded to a point where they will not remain closed. This condition can be corrected by replacing the heater elements with ones of higher rating, providing the wiring capacity is sufficient to carry the current safely. Never hold an overloaded circuit breaker closed by temporary mechanical means because conductors may become over-heated and cause a serious fire.

Luminaires with pull chain sockets are designed for 200 watts or less. It is not good practice to use 300-watt medium base lamps in pull-chain sockets because this means a 50% over-loading of the switch contacts.

When the actual factors that cause trouble are understood, the majority of the lighting troubles can be prevented. Regular inspection of equipment should be practiced. Lamp changers and cleaners should be instructed to report any defective apparatus or equipment that appears to be operating improperly. Thus, the trouble can be immediately corrected and further damage may be prevented.

To obtain maximum utilization of a lighting system with minimum maintenance cost, the following five rules should be observed:

1. Provide easy access to all lighting equipment.
2. Follow a regular cleaning schedule for all luminaires.
3. Replace lamp outages promptly.
4. Keep interior walls and ceilings clean and properly painted.
5. Train the maintenance crew to observe and report luminaires that are defective.

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Dual Units also available.

● CENTER DISC WHEEL

Double Inlet, Double Width.
Reinforced Center Disc.
Designed for Modern Air Conditioning and Heating Applications.
Sizes, 4½" to 50".

● SINGLE INLET WHEELS

For Oil Burner, Stoker, and Air Conditioning Applications.
Sizes, 4½" to 50".
Variety of Blade Lengths for each diameter.

● ENGINEERING DATA

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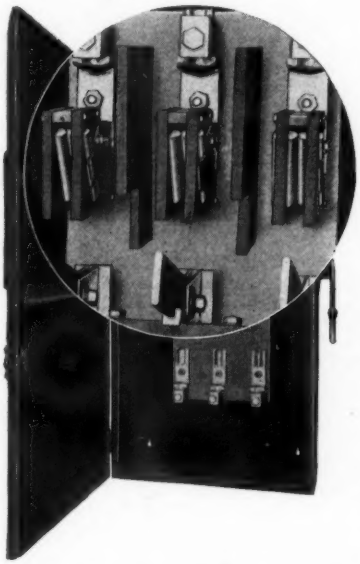
Experienced Engineering Department available to help solve your Air Handling Problems.

BLOWER DIVISION
SCHWITZER-CUMMINS COMPANY
1145 EAST 22ND STREET INDIANAPOLIS, U. S. A.

Rolarc Safety Switch

Federal Electric Products Company, Newark, New Jersey, manufacturers of safety switches, panelboards, switchboards and circuit breakers, has recently developed a new type of long-life Rolarc safety switch.

The Rolarc, available from 100 to and including 400 ampere capacity, incorporates an entirely new principle of arc control. Two cylindrical rollers fabricated from high arc-resistant material, are located immediately above the final disengagement of the current rupturing members. These



rollers form two parallel insulating barriers and are supported by a specially designed spring tension which, in the free position, holds the rollers flush against each other. Therefore, when the switch blade is opened it passes between the lubricated rollers separating them only by the thickness of the blade. Immediately upon the disengagement of the blade from the "line" stationary jaw, the rollers snap tightly together forming an insulated barrier that interrupts the arc. These rollers rotate with each operation of the switch blade reducing friction and presenting a new, cool surface to the influence of the arc.

Performance under actual test has proved that the incorporation of the new Federal Rolarc snuffers lengthens the life of the switch and maintains its condition so that even after many operations under load, it is practically as good as new.

Burndy Pocket Catalog

Something new in catalogs intended for the "man on the job" is the handy Burndy Pocket Catalog. Contained in this catalog are large, clear drawings and illustrations of 75 electrical connector types with their when, where, and how-to-use features; also catalog listings and partial listings of important connector sizes. A full page of helpful wiring data and many other important features all help to make this pocket catalog a veritable gold-mine of information.

Attractively bound in orange and green, this new 48 page catalog, small enough to be carried around in a back or side pocket, is still available without charge, upon request to the Burndy Engineering Co., Inc., New York, New York.

Service Equipment

A revised issue of Square D Company's Bulletin 1000, covering fusible service equipment and meter entrance switches, has just been issued. The service equipment and meter entrance switches described in this bulletin are particularly well adapted for use in defense housing plans, government housing projects, and war workers' homes. A similar bulletin covering circuit breaker and multi-breaker entrance equipment, Bulletin 4000, is also available. For copies of either bulletin, write to Square D Company, Switch and Panel Division, Detroit, Michigan.

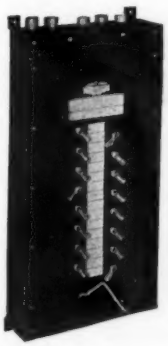
Cast Iron Junction Boxes

The Walker Electrical Company, manufacturers of electrical specialties, Atlanta, Ga., has recently announced a new line of cast iron junction boxes available in a large variety of sizes. Complete specifications on the new line of boxes are given in catalog sheet No. 128, copies of which may be obtained upon request. Cast iron junction boxes with flush type covers provided with cork or velumoid gaskets are available in sizes 3½" x 3½" x 2" to as large as 18" x 24" x 6". These boxes are available both with and without mounting lugs.

There is also available a line of cast iron junction boxes having flanged type screw covers and finished in grey enamel over electrogalvanizing. These boxes are available in sizes from 4" x 4" x 4" up to 18" x 18" x 8". Only the largest box in this line is equipped with mounting lugs. For the present, these boxes are furnished with cork or velumoid gaskets.

Dust-Tight Panelboard

Frank Adams Electric Co., St. Louis, Mo., has announced a new dust-tight panelboard for use in dust-laden atmospheres. The new panelboard is listed by Underwriters' Laboratories, Inc., for "Class II, Groups F and G, Hazardous Locations." This includes atmosphere containing carbon black, coal or coke dust, and grain dust. This panelboard may be used safely in shell loading plants, coal mines, coal storage rooms, flour mills, and similar locations.



It consists of a special cabinet and panelboard of the circuit breaker type —either (F-A) AC or (F-A) Dublbrak, as well as for other types of lighting branch circuit circuit breakers.

Instead of the usual steel front, consisting of trim and door, this panelboard has a solid steel dust-tight front plate, gasketed all around, and secured to the extra-wide flange with screws. The corners of the box are welded, and mounting brackets are welded to the back of the box. Conduit outlets are dust-tight welded hubs. There are no screw openings through the box.

The circuits are externally operable by a mechanism of new (F-A) design. The dust-tight handles operate through bushings riveted directly to the steel cover plate, and engage the regular handles on the circuit breakers inside the cabinet.

Glascote Protects Bulbs

Glascote, a transparent liquid coating, manufactured by John C. Dolph Co., Newark, N. J., is finding extensive use as a preventive for shattering, pitting or scarring of glass. Water white in color and absolutely clear, Glascote will not detract from visibility, nor become opaque with age.

Glascote has proven exceptionally effective in shipyards as a protection for unshielded electric bulbs against welding spatter and rain water. The maximum number of kilowatt hours, as prescribed by lamp manufacturers, are now obtained from lamps even under these hazardous conditions. The brilliancy of the light is in no way affected or retarded.

This Dolph product has been used advantageously where portholes, porcelain fixtures and panelboards require installation before welding operations have been completed. Here again, welding spatter damage has been eliminated by this insulating coating.

This is an unretouched photograph dramatically illustrating the adhesive qualities of Glascote. Although this electric bulb has been crushed, sharp edges of glass do not protrude outside the protective layer.

● SAVE TIME
● CONSERVE MATERIAL
● DO THE JOB FASTER

Wiremold Surface Metal Raceway Systems can be extended or relocated quickly, at low cost. New circuits can be added or changes made in the location of outlets, switches, etc. without breaking into plaster or "fishing" old conduits.

Strong, safe Wiremold Surface Metal Raceway is readily inspectable, less subject to unnoticed deterioration, completely protected. Wiremold Raceways meet all Code and Underwriters' requirements yet compact, thin-wall construction conserves steel.

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